North Dakota Mosquito Surveillance 2004 Program

NORTH DAKOTA
DEPARTMENT of HEALTH

Division
of
Microbiology

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2004 North Dakota Mosquito Surveillance Program's Mission:

Through mosquito collection and speciation, the North Dakota Department of Health (NDDoH) monitors the risk of infection from arboviral encephalitides that are known to occur in this region. The North Dakota Mosquito Surveillance team focuses activities on *Culex tarsalis*, monitoring for increased numbers in the New Jersey Mosquito Trap Network and viral identification using the CDC Miniature Light Mosquito Trap Network. Should mosquito populations reach significant levels or arbovirus activity is detected, appropriate recommendations for mosquito population control will be issued by the NDDoH to the Vector Control districts.

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North Dakota Mosquito Surveillance Program Background

Since 1975, the North Dakota Department of Health has monitored the mosquito populations throughout the state. The Mosquito Surveillance Program traditionally has been activated following arboviral outbreaks or flooding incidences in various locations throughout the state.

The program was first initiated in 1975 following an outbreak of Western Equine Encephalitis (WEE) and St. Louis Encephalitis (SLE) in the United States. In 1977, the program was officially formed under the title *North Dakota Arboviral Encephalitis Surveillance Program* and housed with the Division of Environmental Sanitation and Food Protection. This program was responsible for equine and human arbovirus surveillance until 1989.

The program was reinstated under the name *North Dakota Mosquito Surveillance Program* in 1994 in response to flooding of the Red River in 1993. This program was operated by the Division of Microbiology until 1997.

In 2000, the *North Dakota Mosquito Surveillance Program* was reinstated in response to the 1999 West Nile virus (WNV) outbreak in New York. In 2002, North Dakota had its first confirmed human cases of WNV, as well as detectable virus through laboratory testing in birds, horses and mosquitoes.

The 2003 program was expanded from 50 New Jersey Mosquito Traps to a network of 87 traps and 18 CDC Miniature Light Mosquito Traps. These enhancements provided network coverage statewide. The 2004 program further expanded the trap network to include 94 New Jersey Mosquito Traps and 33 CDC Miniature Light Mosquito Traps. These enhancements ensured uniform surveillance activities statewide. A video was also produced to aid in trap-placement training.

2004 Mosquito Surveillance Program Recommendations

Recommendations from the 2003 North Dakota Mosquito Surveillance Program implemented in 2004:

1. All 53 North Dakota counties, 13 state parks and four reservations became members of the New Jersey Mosquito Trap Network. The network also included participating National Wildlife Refuges within the state. With these additions, uniform surveillance across the state was achieved.
2. A mosquito trap assembly and placement instructional video was produced.
3. 2003 Mosquito report survey was submitted for review.

Recommendations for the 2005 program:

1. Address reducing sporadic contribution of samples by identifying and replacing those operators who did not participate during the 2004 surveillance season.
2. Prepare an organized deactivation plan in the event Mosquito Surveillance Program activities are ceased. Include in the plan a procedure for the return and storage of the New Jersey and CDC Mosquito Traps and accessories.
3. Investigate means to add larviciding capacities to the program.
4. Distribute more adequate collection bags for New Jersey Mosquito Traps.
5. Distribute Mosquito Trap assembly and placement video.

New Jersey Mosquito Trap Network

The New Jersey Mosquito Trap Network monitors mosquito populations throughout the state. By identifying mosquito populations known to be competent encephalitis vectors, the information from the network is used to determine the threat of mosquito-borne encephalitis in various regions of the state.

Thank you to the following New Jersey Mosquito Trap Operators whose dedication and commitment to the North Dakota Department of Health Mosquito Surveillance Program made the 2004 program a success!

2004 New Jersey Mosquito Trap Operators

• Indicates State Parks ** Indicates National Wildlife Refuge

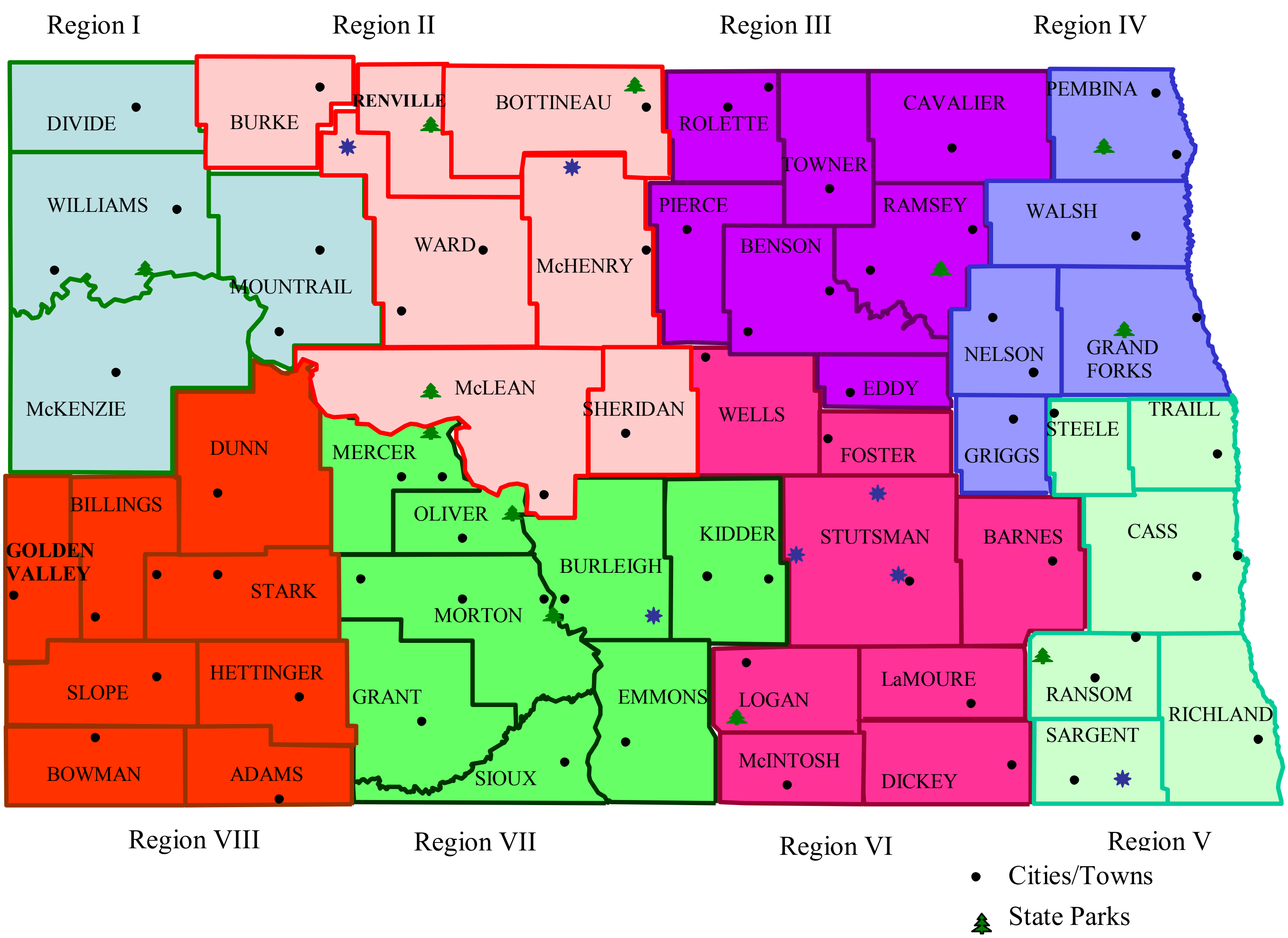
Location	Trapper		Location	Trapper		Location	Trapper	
Almont	Idar Handegard		Chase Lake Prairie Project NWR**	David Bolin		Dickinson	Kevin Pavlish, Skip Rapp	
Amidon	Teresa Baumann		Cooperstown	Julie Ferry, Lyle Sherrard		Drayton	Tim Midboe	
Arrowwood NWR**	Paulette Scherr		Crosby	Dennis Lampert		Edmore	Roger Nygard	
Ashley	Marcus Lynn		Cross Ranch*	Dennis Clark		Elgin	Norman Schock	
Beach	Alvin & Betty Tescher		Devils Lake	Myron Asleson, Leroy Axdahl		Enderlin	Rick Gillund, Glen Fuhrman	
Beaver Lake*	Steve Wipperling		Finely	Diane Jacobson		Fargo	Don Russiff, Elisha Kabanuk	
Belcourt	Jen Malaterre		Formen	Colleen Sundquist		Hillsboro	Jim Anderson	
Belfield	Susan Heck		Fort Ransom*	John Kwapinski		Icelandic*	Henry Duray	
Beulah	Keith Johnson		Fort Stevenson*	Richard Messerly		Indian Hills Rec Area*	Byron & Tolly Holtan	
Bismarck	Mel Fischer		Fort Totten	Hilda Garcia		J. Clark Sayler NWR**	Gary Erickson	
Bottineau	Sue Brandvold		Fort Yates	Bill Sherwood		Jamestown	Steve Reidburn	
Bowbells	Petter Willyard		Ft. Abraham Lincoln*	Dan Scheleske		Lake Isabel	Lana Fischer	
Bowman	Brenda Rettinger		Grafton	Mike Huska		Lake Sakakawea*	John Tunge, Dave Leite	
Cando	Terry Harland		Grahams Island*	Dick Horner, Trevor Retterath		Lamoure	Tony Hanson, Leslie Hanson	
Carrington	Bobbi Indergaard		Grand Forks	Todd Hanson		Langdon	Rob Gilseth	
Carson	Norman Schock		Harvey	Karen Volk, Loren Stolz		Lewis & Clark*	Helen Volk Schill	
Casselton	Don Russiff, Elisha Kabanuk		Hazen	Keith Johnson		Linton	Bev Voller	
Cavalier	Terri Gustafson		Hebron	Chad Stern, Lance Elmer		Lisbon	Randy Seelig	
Center	Keith Johnson		Hettinger	Andrea Bowman		Long Lake NWR**	Gregory Knutson	
Maddock	Jean Mosser		Napoleon	Andy Gross		Tewaukon NWR**	Kristine Askerooth	
Mandan	Dick Bechtel, Vawnita Best		New Rockford	George Ritzke		Tioga	Don Zacharias, Kirk Odegard	

New Jersey Mosquito Trap Operators, Continued:

Location	Trapper		Location	Trapper		Location	Trapper	

Manning	Kevin Pavlish		New Town	Kerry Hartman		Towner	Terry Harland	
McClusky	Dallas and Mariam Bold		Northern Prairie Wildlife Research **	Bob Woodward		Turtle River*	Steve Crandall, James Loken	
McVille	Julie Ferry, Rick Haabeck		Oakes	Robert Schaefer		Upper Souris NWR**	Thomas Pabian	
Medicine Lake NWR**	Beth Madden		Pembina	Kathy Johnson		Valley City	Jeff Diferding	
Medora	Bruce Kaye		Ramsey	Allen McKay		Wahpeton	Shawn Kessel	
Minot	Jim Heckman		Rollette	Jen Malaterre		Washburn	Sandy Birst	
Mott	Kim Kibbel		Rugby	Jeanette Mygland		Watford City	Robert Nelson	
Mouse River	Jim Heckman		Ryder	Jody Reinsch		Williston	Gene Gafkjen, Mike Melius	
Lake Metigoshe*	Larry Hagen		Steele	Diane Jacobson		Wuabay NWR**	Laura Hubers	

2004 New Jersey Mosquito Trap Surveillance Sites & Regions



New Jersey Mosquito Trap Network Information

In 2004 the New Jersey Mosquito Trap network had a total of 94 traps across North Da[illegible] were 73 traps within cities and Indian reservations, nine in State Parks and eight in National Wildlife Refuges.

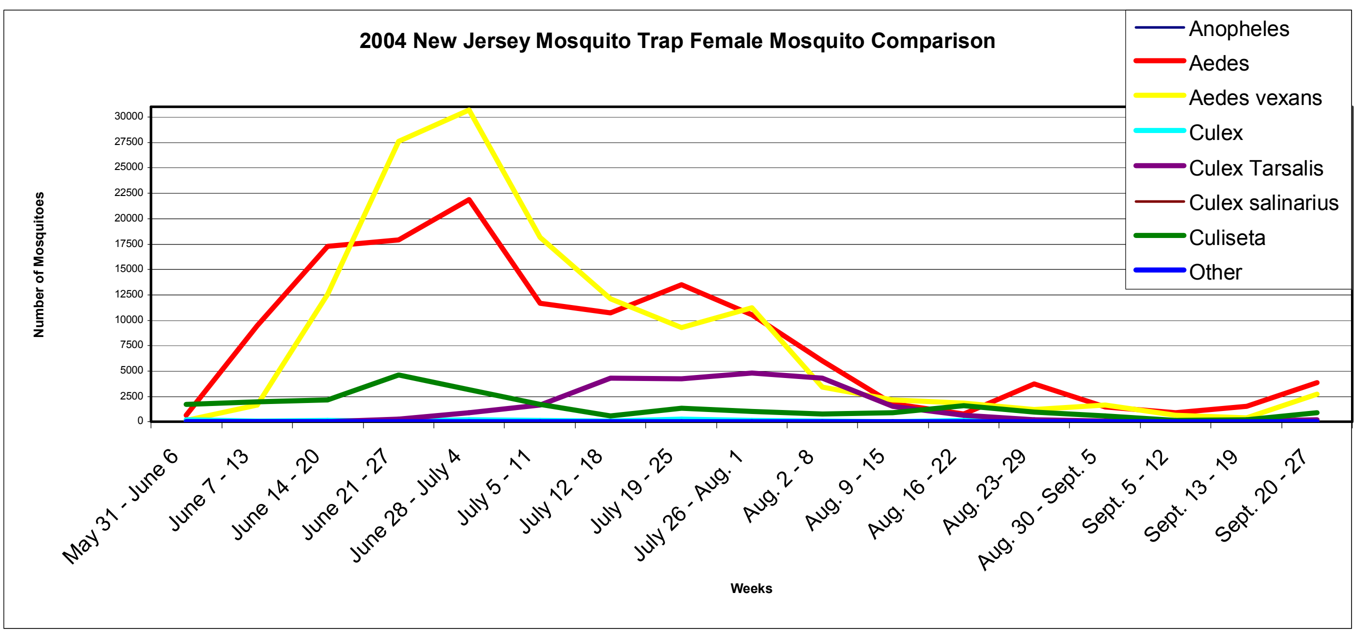
Two New Jersey Mosquito Traps were located in each urban area with a population greater than 7,000 citizens.

Each year, the New Jersey Mosquito Trap operator installs a trap in a suitable location at the beginning of mosquito season in May. Using a programmable timer, the trap is set to operate between the hours of 8:30 p.m. and 7 a.m. seven nights a week. At the end of the seven-day period the trap contents are collected and sent to the North Dakota Public Health Laboratory (NDPHL) in Bismarck for counting and speciation. This process is repeated weekly until the end of mosquito season in September.

At the NDPHL, the mosquito surveillance personnel sort the mosquitoes into sex and genera. Since male mosquitoes do not bite, they are of little health concern. However, their numbers are monitored because male mosquitoes hatch first and increased numbers may indicate a future female mosquito population boom. The female mosquitoes are separated into four genera - *Anopheles*, *Aedes*, *Culex* and *Culiseta* - and enumerated.

The North Dakota Department of Health monitors for four genera:

- *Anopheles* is associated with malaria and West Nile virus.
- *Aedes* is associated with illnesses such as canine heartworm, LaCrosse encephalitis (LCE), Eastern Equine encephalitis (EEE), Western Equine encephalitis (WEE), California encephalitis (CAE), and West Nile virus (WNV). Although *Aedes vexans* has been shown to be capable of laboratory transmission of WNV, its mammalian feeding preferences decrease its potential as an enzootic vector for WNV.
- *Culex* is the mosquito of greatest public health concern in North Dakota, since all species are competent vectors of SLE, WEE and WNV. The species most commonly associated with encephalitis in North Dakota is *Culex tarsalis*, a principal arbovirus vector in rural agricultural ecosystems.
- *Culisetas* are monitored due to its association with Eastern Equine Encephalitis.



2004 New Jersey Mosquito Trap Count Totals for Each Week

	Male	Female	Total Mosquitoes

Week of		Anopheles	Aedes	Aedes vexans	Culex	Culex tarsalis	Culex salinarius	Culiseta	Other	Total Female	
May 31 - June 6	1418	56	633	133	177	24	0	1741	6	2770	4188
June 7 - 13	23755	45	9488	1628	69	30	6	1940	1	13207	36962
June 14 - 20	53932	110	17257	12560	153	33	0	2169	0	32282	86214
June 21 - 27	41471	3	17926	27603	102	272	4	4604	0	50514	91985
June 28 - July 4	17257	17	21896	30705	182	911	8	3175	0	56894	74151
July 5 - 11	6171	49	11666	18190	118	1623	0	1703	0	33349	39520
July 12 - 18	5202	0	10734	12082	58	4293	0	599	0	27766	32968
July 19 - 25	13539	54	13500	9274	254	4225	20	1321	0	28648	42187
July 26 - Aug. 1	10517	79	10539	11219	152	4831	49	1043	0	27912	38429
Aug. 2 - 8	5994	99	6031	3435	99	4279	8	762	0	14713	20707
Aug. 9 - 15	5195	115	1792	2176	41	1508	0	891	0	6523	11718
Aug. 16 - 22	4854	26	751	1827	123	630	0	1561	0	4918	9772
Aug. 23-29	4089	50	3703	1224	17	213	0	938	0	6145	10234
Aug. 30 - Sept. 5	1973	78	1442	1662	5	95	0	569	0	3851	5824
Sept. 5 - 12	1365	8	883	655	5	42	0	143	3	1739	4843
Sept. 13 - 19	1715	18	1523	379	150	61	0	177	0	2308	6331
Sept. 20 - 27	5053	104	3848	2696	160	198	0	889	3	7898	16998
2004 Year Totals	**198447**	**807**	**129764**	**134752**	**1705**	**23070**	**95**	**23336**	**10**	**313539**	**516033**

CDC Miniature Light Mosquito Trap Network

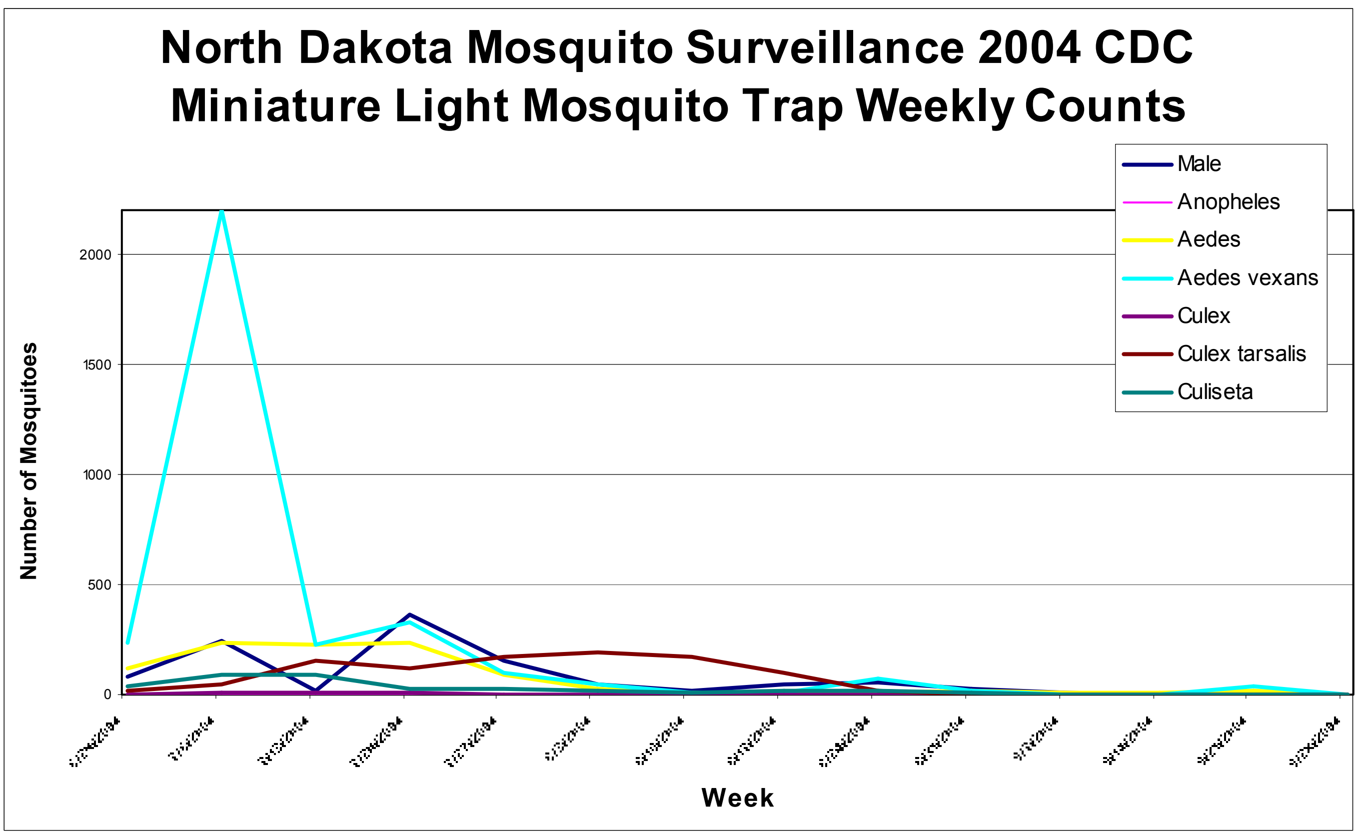
The CDC Miniature Light Mosquito Trap Network monitors mosquito populations known to be competent encephalitis vectors. The information from the network can be used to determine the threat of mosquito-borne encephalitis in various regions of the state. In 2004, the CDC Miniature Light Trap Network included 21 locations within the state and two locations out of state (Montana and South Dakota).

Thank you to the following CDC Miniature Light Mosquito Trap Operators!

<u>2004 CDC Miniature Light Mosquito Trap Operators</u>

*** Indicates State Parks ** Indicates National Wildlife Refuge**

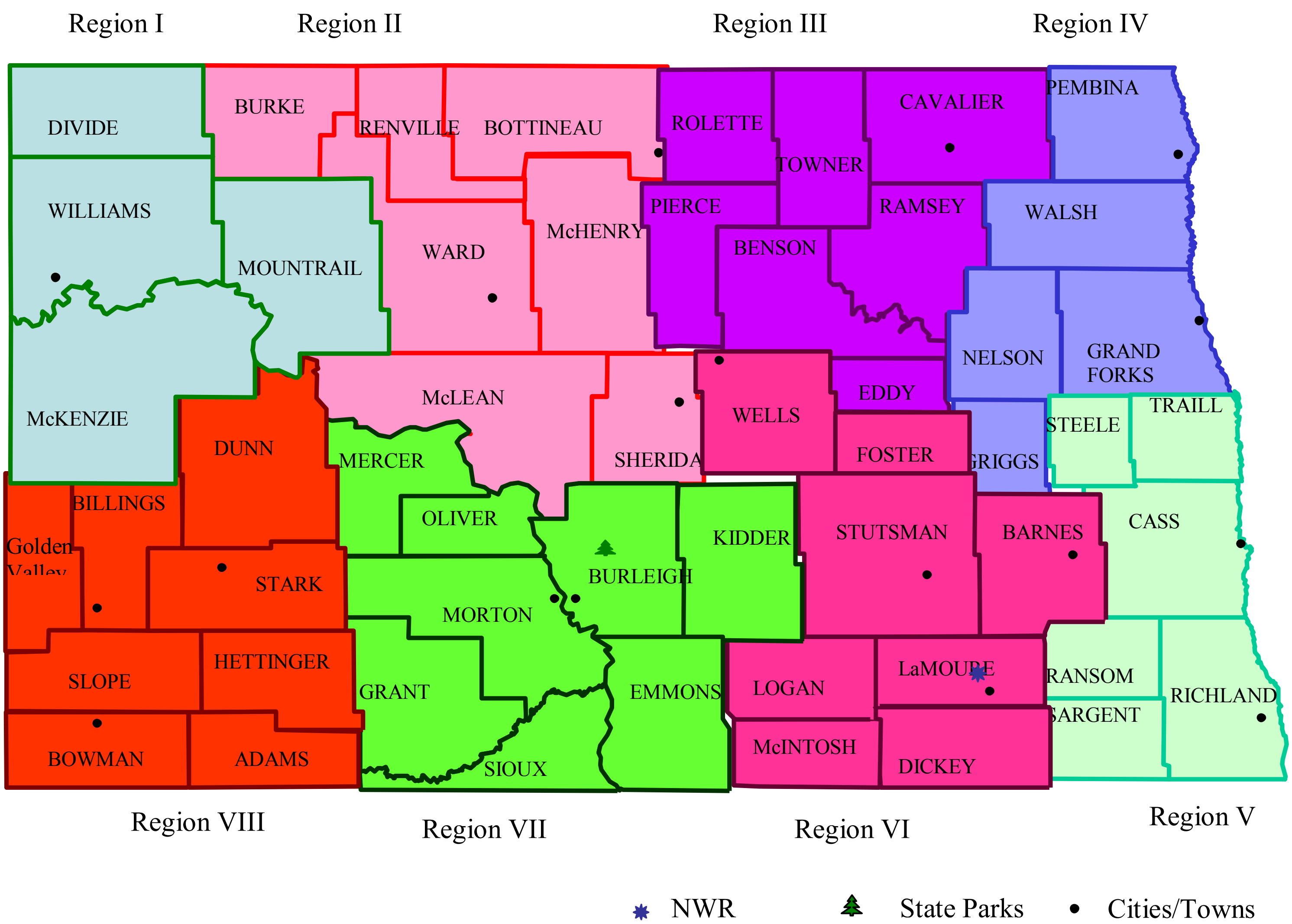
Location	Trapper	Location	Trapper	Location	Trapper
Bismarck	Jay Swanson, Pam Weigel	Grand Forks	Todd Hanson	Medora	Bruce Kaye
Bottineau	Sue Brandvold	Harvey	Loren Stolz	Minot	Mark Syverson
Bowman	Brenda Retinger	Jamestown	Steve Reidburn	Towner	Nikki Medalen
Chase Lake NWR	David Bolin	Lake Sakakwea	John Tunge, Dave Leite	Valley City	Jeff Differding
Devils Lake	Allen McKay	LaMoure	Tony Hanson, Leslie Hanson	Wahpeton	Shawn Kessel
Dickinson	Kevin Pavlish	Langdon	Rob Gilseth	Waubay NWR	Laura Huber
Drayton	Tim Midboe	Mandan	Jennifer Hoff	Williston	Dave Benth
Fargo	Don Russiff, Elisha Kabanuk	Medicine Lake NWR	Beth Madden		



The CDC Miniature Light Mosquito Trap is a battery-operated carbon-dioxide-baited trap that allows collection of mosquito specimens for laboratory testing. The traps are set up in suitable mosquito trapping locations in the evening, baited with carbon dioxide and collected the next morning. The samples are then placed in shipping coolers with icepacks to preserve any virus present and sent to the NDPHL for speciation. At the laboratory, the collection is speciated and counted. The *Culex tarsalis* is separated from the collection and placed in pools of up to 50 mosquitoes. The pools are then tested using a nucleic acid amplification procedure to detect the presence of West Nile virus. Testing of 2004 mosquito pools resulted in no detection of WNV.

In 2004, the CDC Miniature Light Mosquito Trap Network expanded to include 33 CDC Miniature Light Mosquito Traps in 23 locations across the state. The CDC trap network began its first week of operation the last Tuesday night in June. The network then operated once a week, usually Tuesday night, until the first Tuesday night in September.

<u>2004 North Dakota CDC Miniature Light Mosquito Trap Network Sites</u>



<u>Arbovirus Information</u>

More than 2,500 different species of mosquitoes are found worldwide, with about 200 species in the United States. The most common vector in the spread of arboviruses is the mosquito; however, not all mosquitoes are vectors in the transmission of arboviruses.

Male mosquitoes feed almost exclusively on nectar and therefore do not bite. Female mosquitoes lay mosquito eggs that require a blood meal and bite animals, warm or cold-blooded, and birds. Stimuli that influence biting include a combination of carbon dioxide, temperature, moisture, smell, color and movement. Humans are seldom the first or second choice for a blood meal. Horses, cattle, smaller mammals and birds are preferred. Although acquiring a blood meal is essential for egg production, both male and female mosquitoes are mainly nectar feeders.

Mosquito-borne diseases cause more than one million human deaths every year. Some of these diseases include protozoan infections, such as malaria; filarial pathogens, such as canine heartworm; and viruses that cause dengue, yellow fever and encephalitis.

Arthropod-borne viruses (arboviruses) are the most diverse and serious diseases transmitted to susceptible vertebrate hosts by mosquitoes. All arboviral encephalitides are zoonotic involving a nonhuman primary vertebrate and a primary arthropod vector. Humans and domestic animals can develop clinical illness but usually are "dead-end" hosts because they do not contribute to the transmission cycle.

West Nile virus (WNV) is the most recently emerged arbovirus in North America. West Nile virus is named after the West Nile region of Uganda where it was first discovered in 1937. *Culex* species of mosquitoes are the primary vectors. Common in many parts of the world, WNV had not been seen in the United States until late summer 1999, when it made its debut in New York. WNV then proceeded to travel westward across the continent the following year. West Nile fever can be characterized by fever, headache and rash to more serious symptoms. Although only a small percentage of people infected with WNV display symptoms, WNV can cause encephalitis (an inflammation of the brain) and meningitis (inflammation of the brain and spinal cord) in humans and animals.

Western Equine encephalitis (WEE) is mostly found in states west of the Mississippi River. The primary vector is *Culex tarsalis.* Birds are the most important host. Since 1964, there have been fewer than 1,000 cases reported. Human mortality rates are about 5%, with horse mortality rates considerably higher.

Eastern Equine encephalitis (EEE) is spread to horses and humans by infected mosquitoes. Annually, there are a small number of cases nationwide. EEE is the most serious of the arboviruses that can affect the central nervous system (CNS), resulting in severe complications and even death. Symptoms may range from none at all to flu-like to more serious infections with sudden fever and severe headache followed by seizures and coma. About half of patients die, and of those who survive, many suffer permanent CNS damage.

St. Louis encephalitis (SLE) is transmitted from birds to mammals by an infected mosquito. SLE was discovered in 1933 in St. Louis, Missouri. Since then, SLE has been reported in 46 states. Most infections of SLE do not result in illness, with mild cases exhibiting aseptic meningitis or fever. The elderly and very young children are more susceptible, with fatality rates from 2% to 20%, and neurologic dysfunction occurring in about 1% of survivors.

The California serogroup is a group of several related viruses that included California encephalitis, La Crosse encephalitis, and Jamestown Canyon virus. Each year, about 75 cases are reported in the United

Stated, with the majority of the illnesses resulting from La Crosse encephalitis. The California serogroup viruses primarily affect male children younger than 16. Infections are mild, with a mortality rate of about four deaths per 1,000 infections.

North Dakota Mosquito Surveillance Risk Assessment Chart For Arbovirus Activity

Risk Category	Probability of Human Outbreak	Definition of Conditions	Recommended Response by Mosquito Surveillance Team and North Dakota Vector Control Personnel
1a	Remote	Mid-season; first week of July; no observed epizootic activity; low population counts of vector species from New Jersey Trap Network	Begin preliminary, low-intensity CDC live-trapping network and testing in all areas of the state; test for targeted virus presence.
1b		Late-season; third week of July through September; no observed epizootic activity; high population counts from New Jersey Trap Network	Deploy mid-intensity CDC live-trapping network and viral testing in areas with high population counts of targeted vector species; continue low intensity trapping and testing in other areas.
2	Low	Sporadic epizootic activity in birds or mosquitoes	Deploy high intensity CDC live-trapping network and viral testing in epizootic areas, and consider preliminary control measures such as source reduction and larval control; continue surveillance in other areas.
3	Moderate	Initial confirmation of virus in horse or human; moderate activity in birds or mosquitoes	Continue as in Category 2; consider adult mosquito-control as indicated by surveillance activity.
4	High	Measures suggesting high risk of human infection (for example, high dead bird densities, high mosquito infection rates, multiple positive mosquito species, horse or mammal cases indicating escalating epizootic transmission, or a human case)	Response as in Category 3; initiate adult mosquito control program in areas of potential human risk.
5	Outbreak in progress	Multiple confirmed human cases; conditions as listed in Category 4	Implement emergency adult mosquito-control program; if widespread, consider aerial spraying.

Appendix A
New Jersey Mosquito Trap Data Analysis

The following graphs depict the relation of each 2004 Mosquito Surveillance Region's weather and mosquito population data for 2004. The following information is an explanation on how the weather can affect mosquito populations.

Monitoring mosquito populations in relation to temperature and rainfall is essential in a mosquito surveillance program. Over time, information about how weather patterns alter mosquito populations can help in the prediction of increased mosquito activity and possible arbovirus activity throughout a region. On the following pages, regional graphs compare the relationship between mosquito populations, temperature and rainfall accumulations.

The mosquito's life cycle has four separate and distinct stages: egg, larva, pupa and adult. A female mosquito breeds in the presence of water and lays fertile eggs after obtaining a blood meal. The location in which a female mosquito deposits her eggs in the environment depends upon larval habitat preference. (15) The 36 mosquito species indigenous to North Dakota can be grouped into four categories that reflect their larval habitat preference. These categories include the permanent pool group, the transient water group, the floodwater group, and the artificial container and tree-hole group.

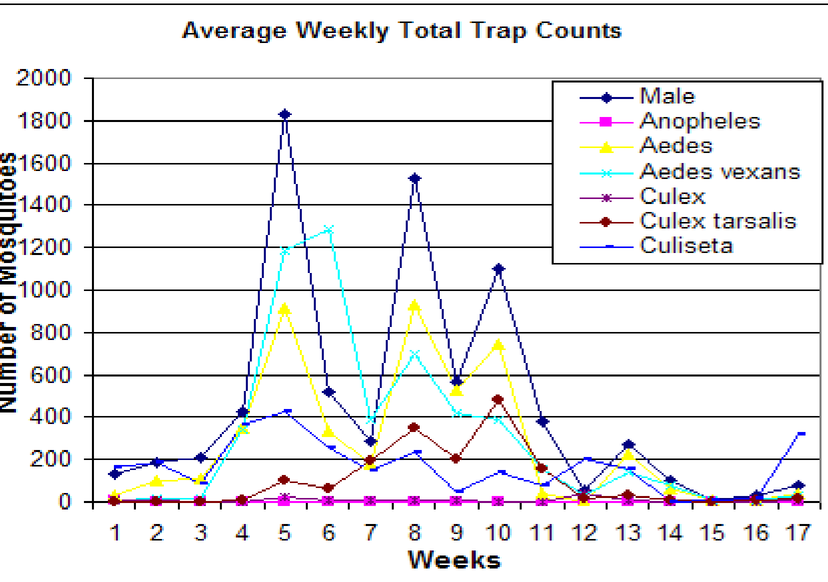
Mosquitoes within the **permanent pool group**, *Anopheles* and *Culex* species, lay eggs either singly or side by side on the water surface of permanent ponds and lakes. Permanent pool mosquitoes can develop continuously in warm water and hatch daily into adults. **Transient water mosquito** such as *Culex tarsalis* prefer to lay their eggs in pools of a temporary nature. Common habitats of the transient water group are roadside ditches, canals, ground pools and irrigated lands. Transient water mosquito eggs in ditches and small depressions must wait until rainfall to begin the hatching process. **Floodwater mosquitoes**, the *Aedes* species, lay eggs singly on damp soil or along vegetated shorelines and remain dormant until these areas are flooded. Once flooded, the eggs hatch if conditions are favorable. Large numbers of larvae emerge, and adults can appear as early as six days after flooding. A major rainstorm, a series of showers, or irrigation sufficient enough to produce standing water promotes hatching in the floodwater species of mosquitoes. The **artificial container and tree-hole group of mosquitoes** place their eggs inside the wall of a container or depression inside a tree, at or above the water line, and the eggs hatch when the water levels rise A heavy rain resulting in standing water in old tires, tin cans and flowerpots will begin the hatching process for artificial container mosquitoes.

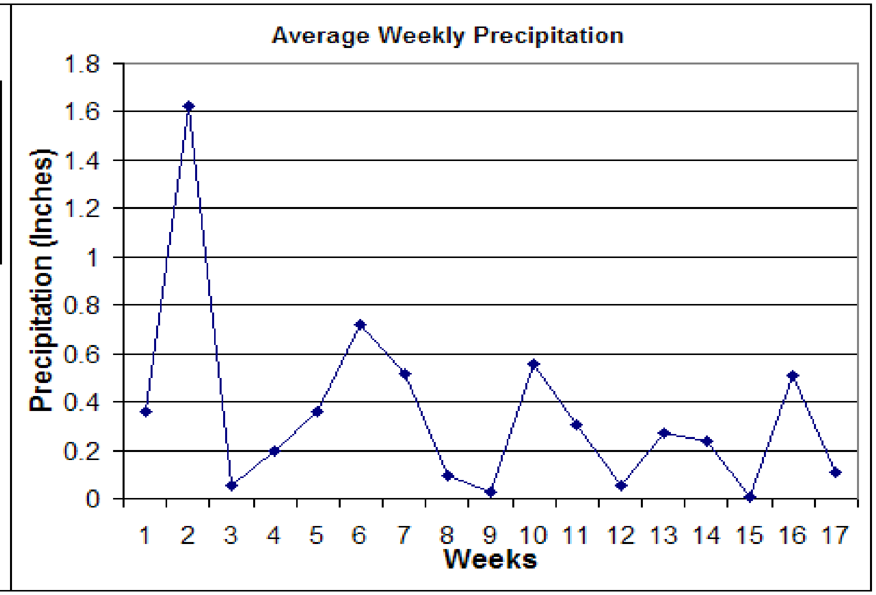
Once hatched, larvae of all species emerge and live in water. After four stages, or instars, the larva molts into a pupa. The pupa stage is a resting, non-feeding stage where the pupa is encased until the adult matures and emerges from the skin after one-and-a-half to four days. Adult male mosquitoes hatch first and live from six to seven days. Female mosquitoes can live for about two weeks but have been found to survive for up to five months with ample food. Peak adult mosquito populations usually appear within two weeks after a number of eggs hatch.

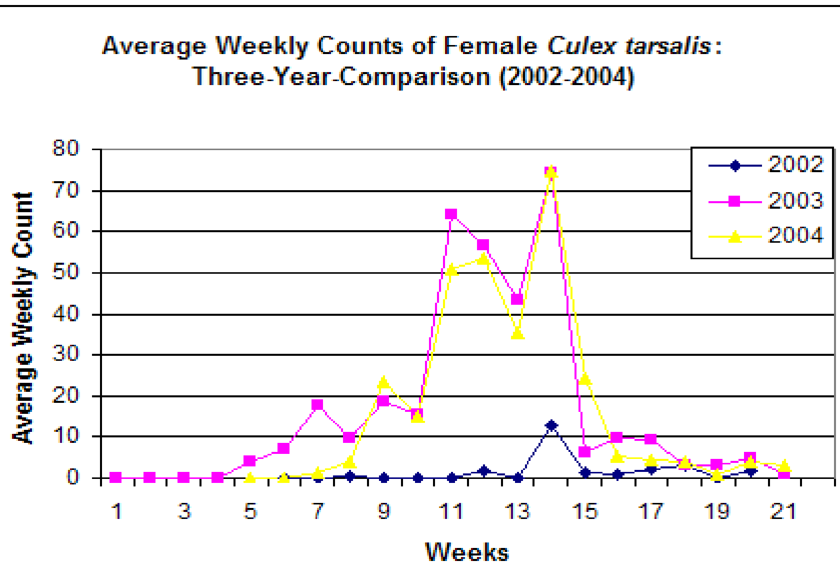
Along with increased rainfall, warmer water temperatures speed up hatching and larval development. If outdoor temperatures are 50° F or more, productive breeding sites readily produce mosquito larvae. With increasing water temperatures, large mosquito populations can emerge within one week. Research in laboratory settings has shown that if the water temperature exceeds 100° F, it takes only three to four days for larval metamorphosis; if the temperature is 90° F, it takes five days; and a lower water temperature of 70° F decreases rate of growth to 10 days. Floodwater species of *Aedes* larvae generally metamorphose within five to seven days after hatching. The species *Culex tarsalis* completes its life cycle in 14 days at 70°F and in only 10 days at 80°F. On the other hand, some species have naturally adapted to go through their entire life cycle in as little as four days or as long as one month.

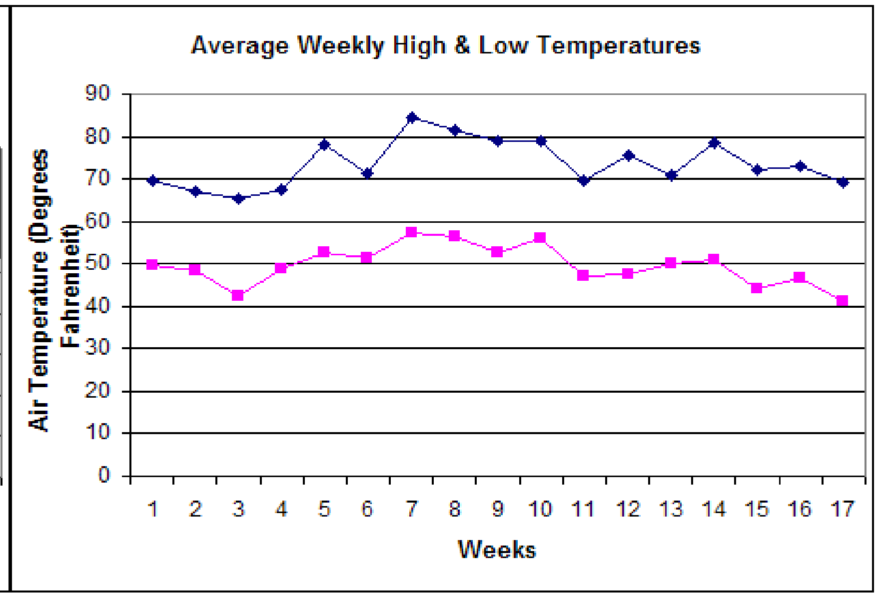
When a mosquito becomes an adult, the weather elements affect its peak activity. Most mosquitoes are active from dusk until dawn when wind speeds are less than eight miles per hour, the air temperature is between 65°F and 80° F, and the weather is moderate. Heavy rains, gusting winds, and cool or high daytime temperatures all limit a mosquito's feeding activity. At temperatures lower than 50°F, mosquitoes become sluggish, reducing their host-seeking behavior. At higher temperatures, usually during daytime hours, adult mosquitoes seek cover in vegetated or humid areas with shade.

North Dakota Mosquito Surveillance Region I
New Jersey Mosquito Trap Data Analysis

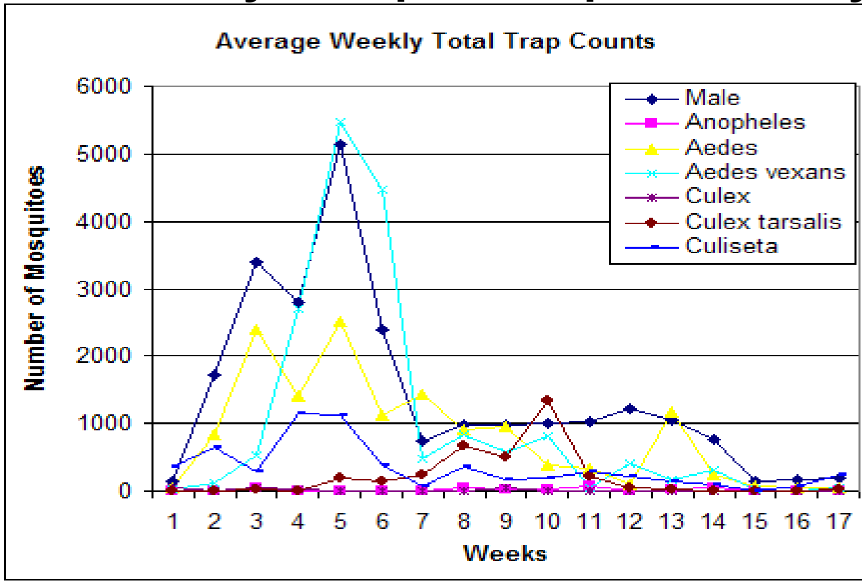


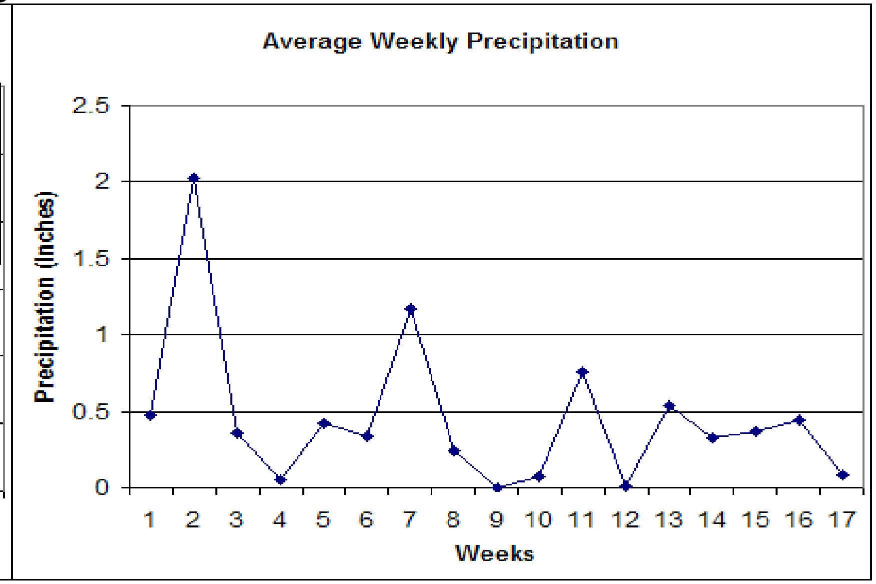


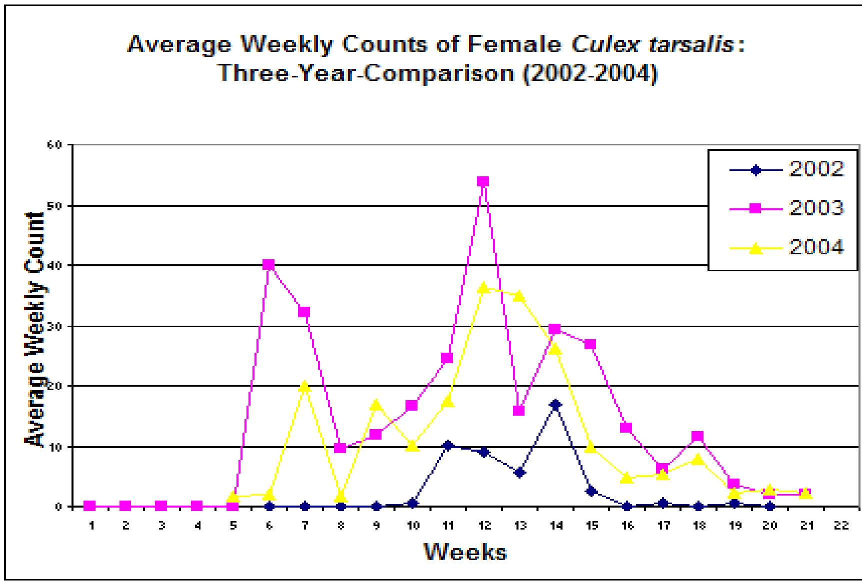


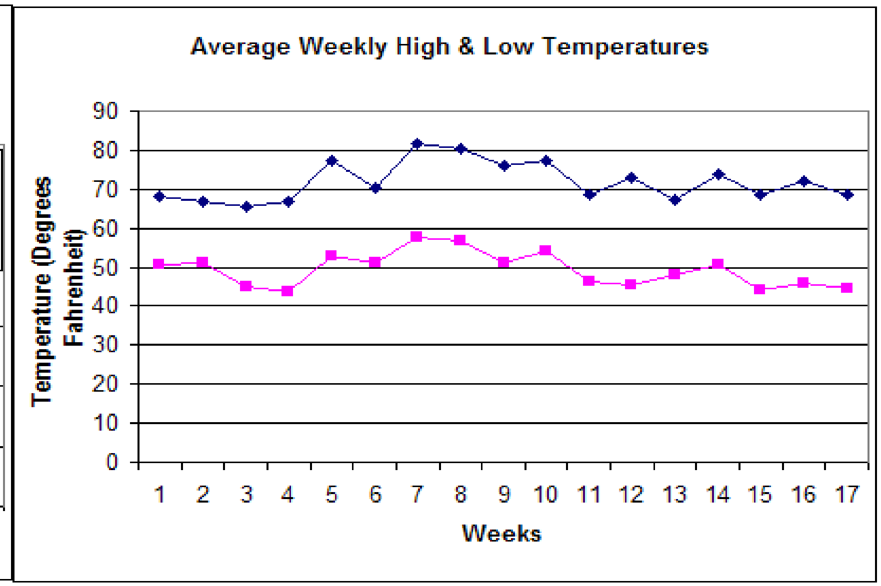


2004 North Dakota Mosquito Surveillance Region II
New Jersey Mosquito Trap Data Analysis

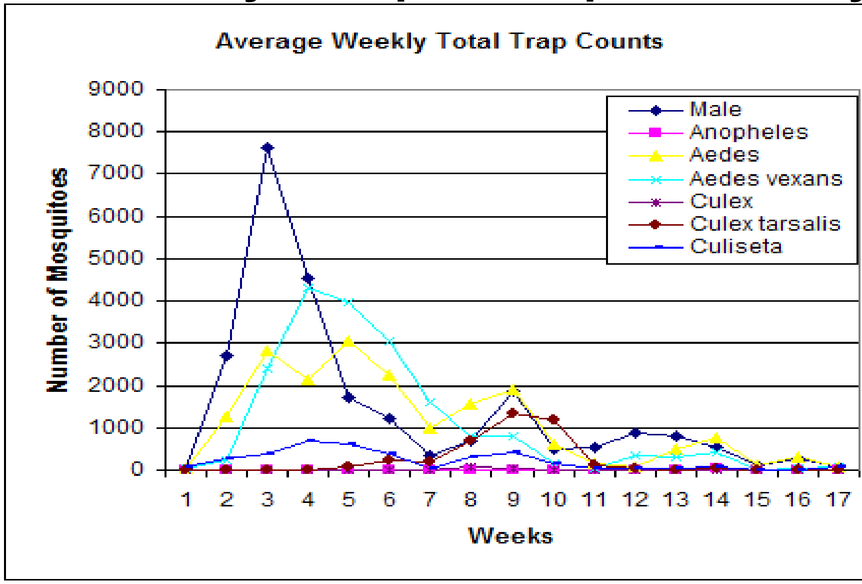


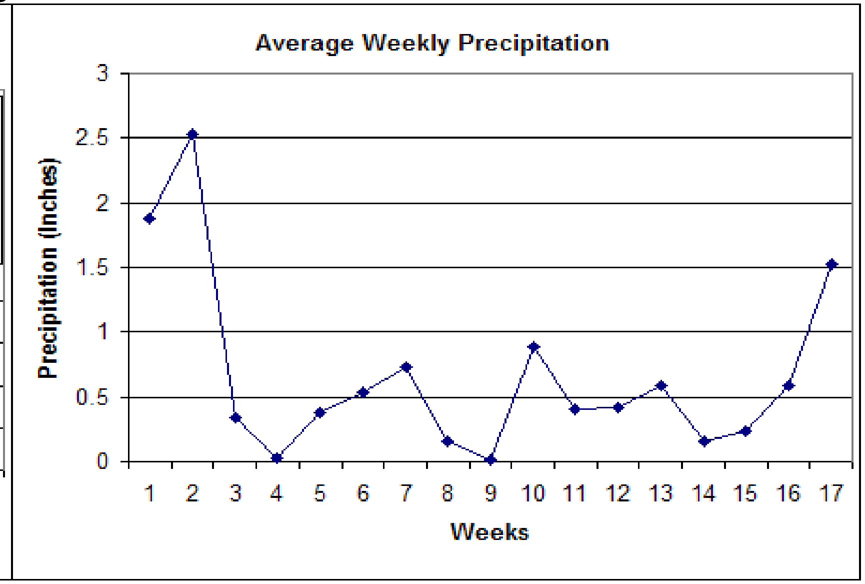


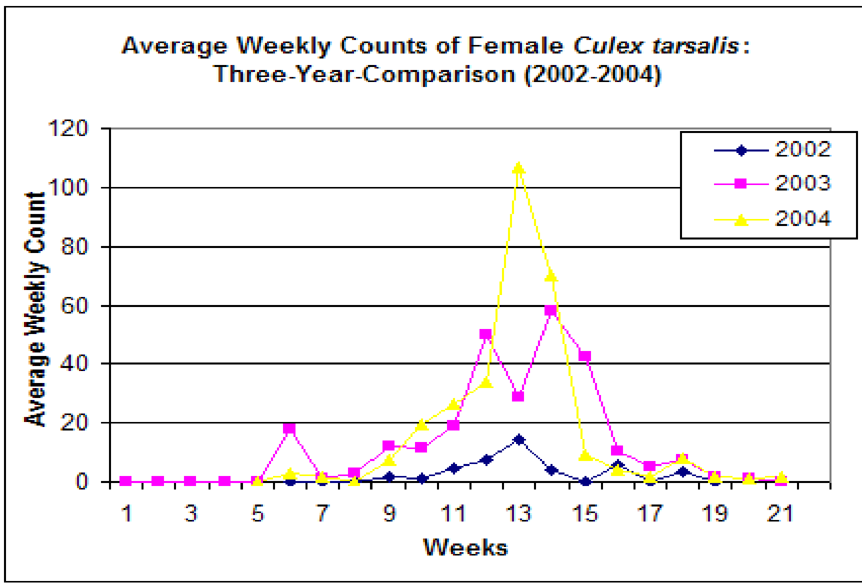


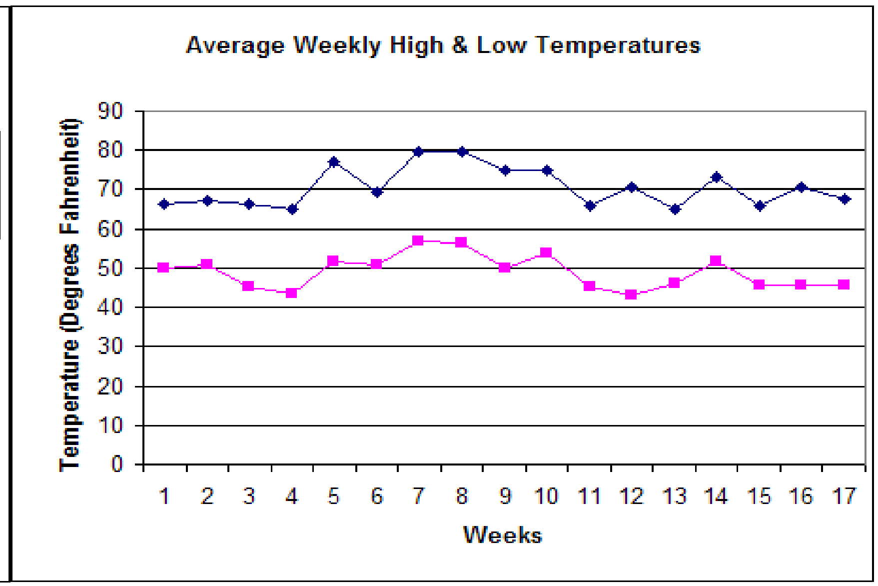


2004 North Dakota Mosquito Surveillance Region III
New Jersey Mosquito Trap Data Analysis

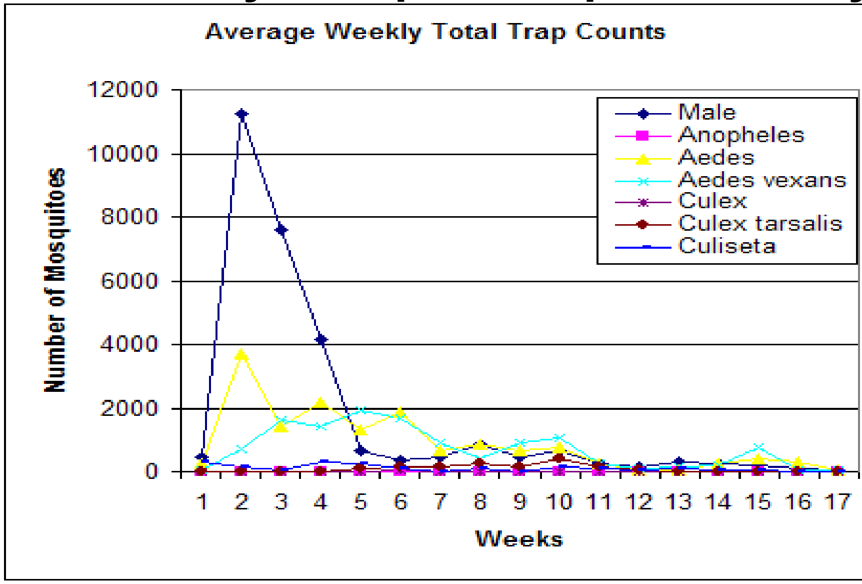


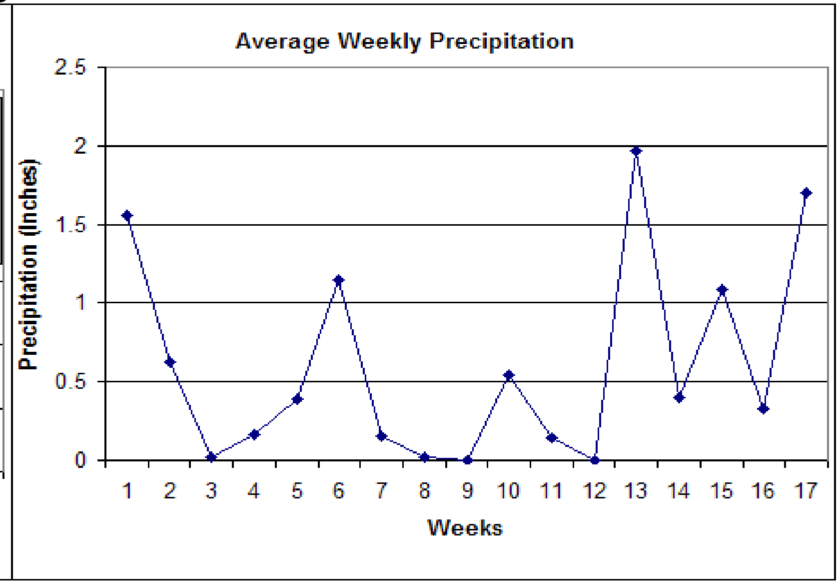


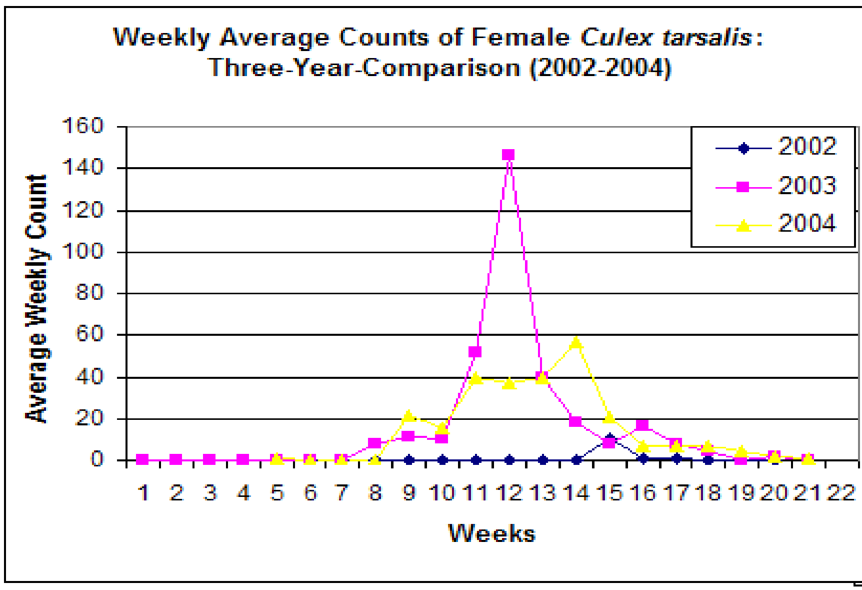


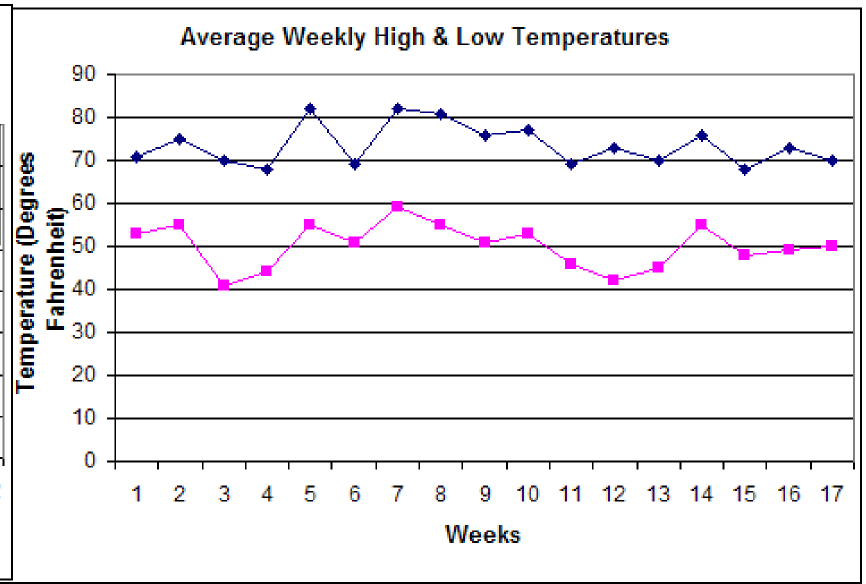


2004 North Dakota Mosquito Surveillance Region IV
New Jersey Mosquito Trap Data Analysis

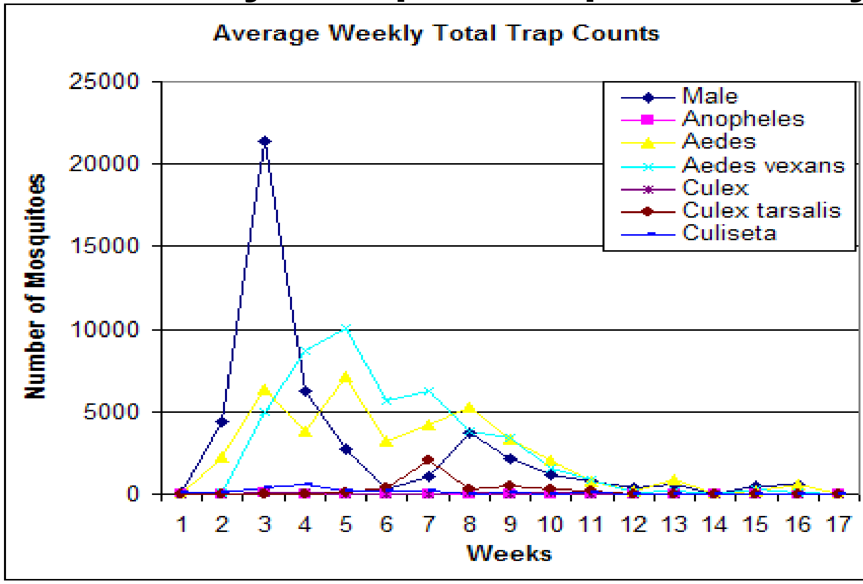


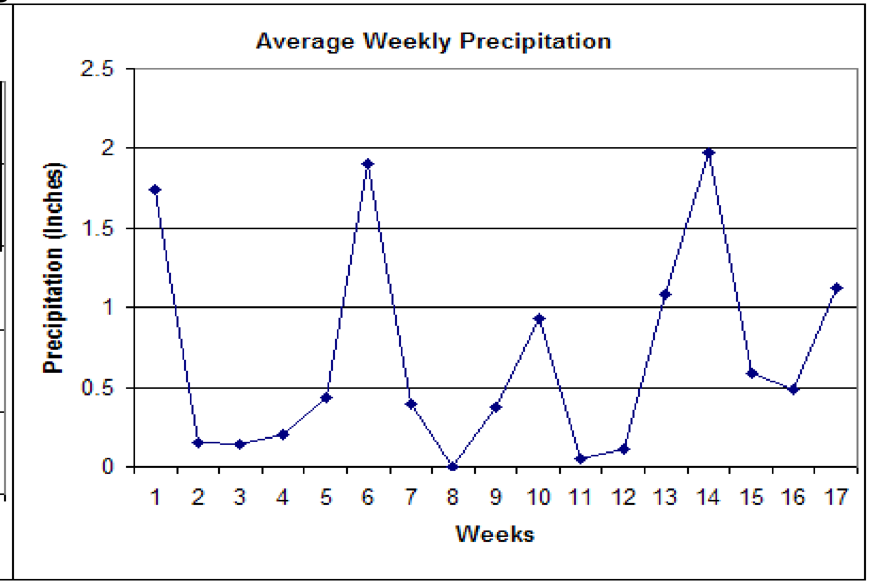


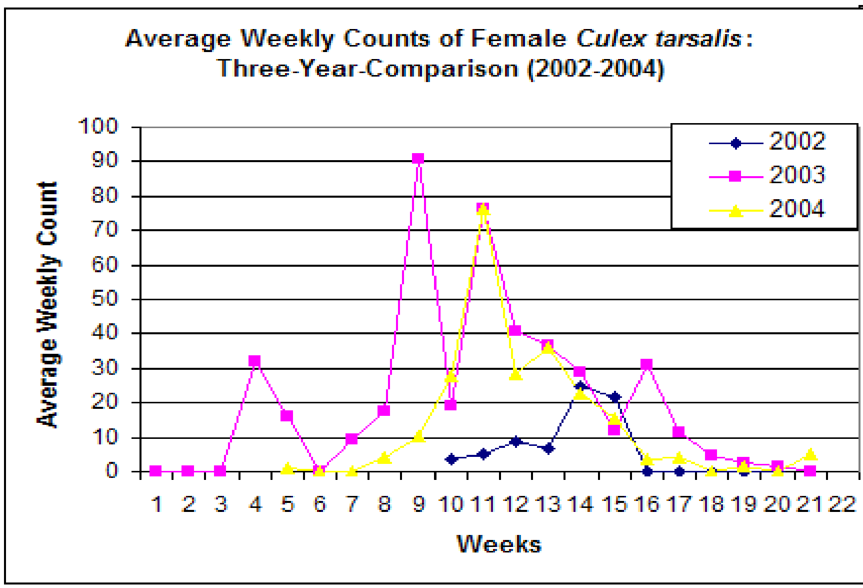


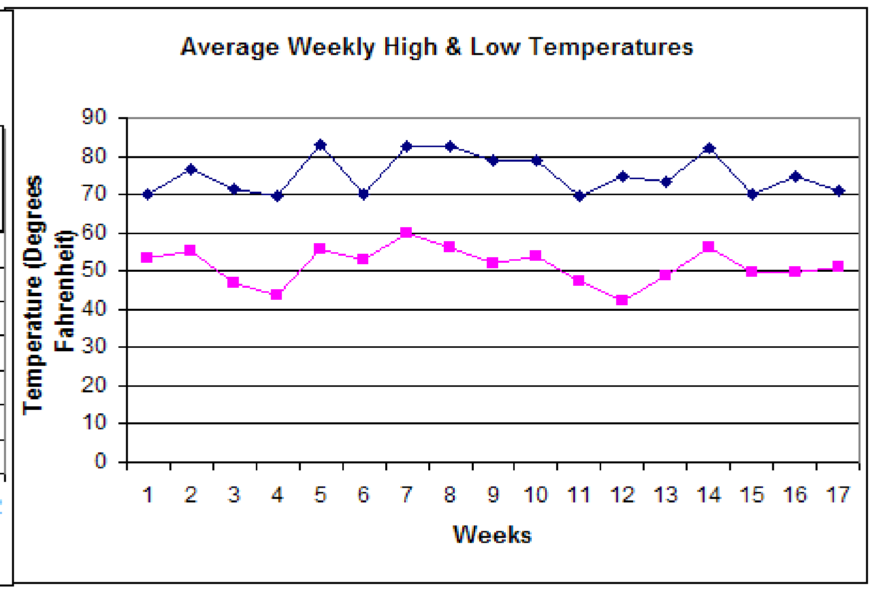


2004 North Dakota Mosquito Surveillance Region V
New Jersey Mosquito Trap Data Analysis

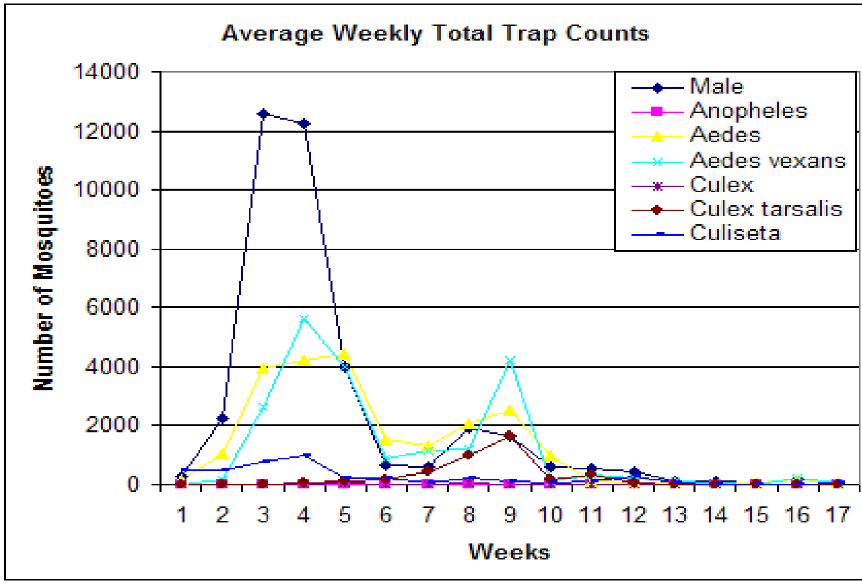


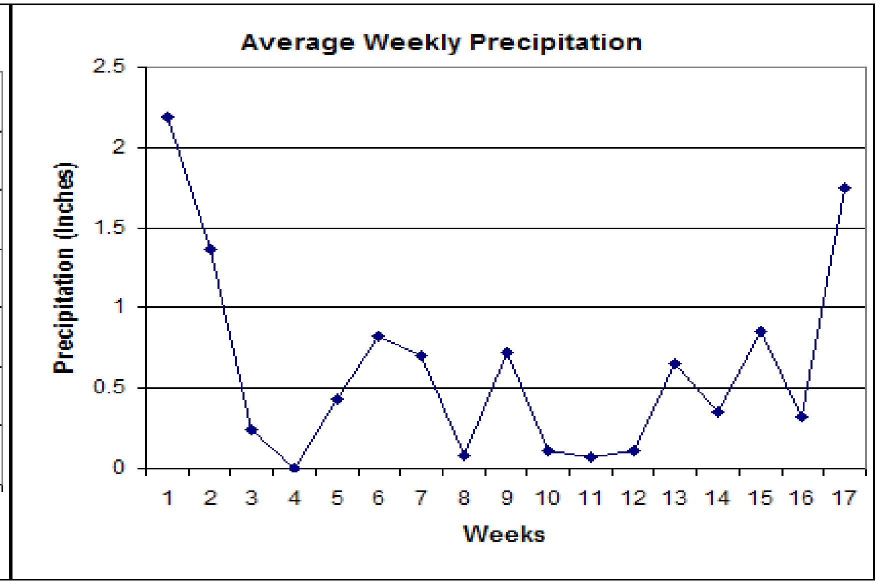


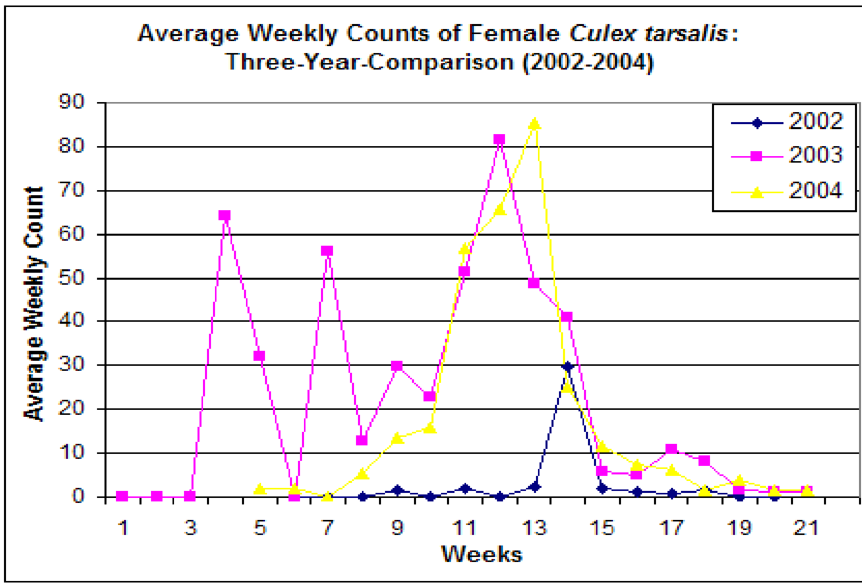


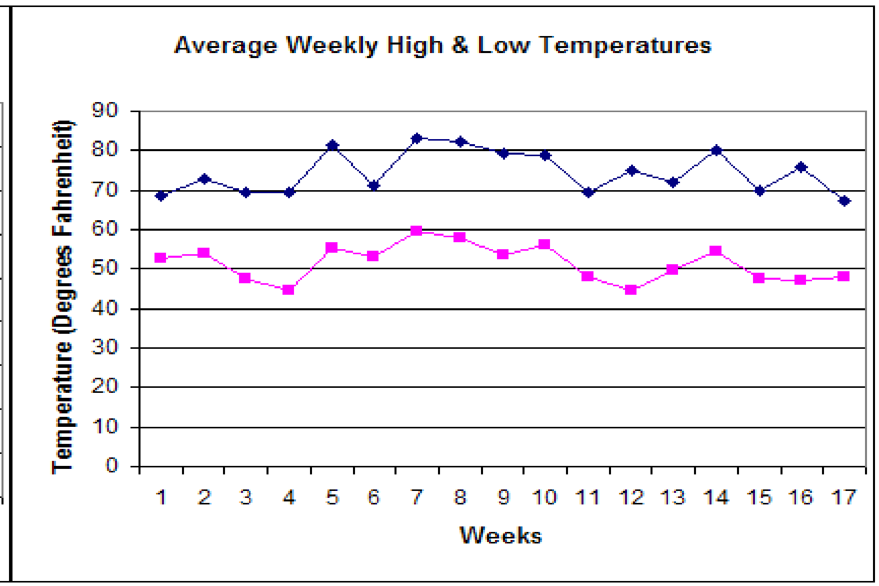


2004 North Dakota Mosquito Surveillance Region VI
New Jersey Mosquito Trap Data Analysis

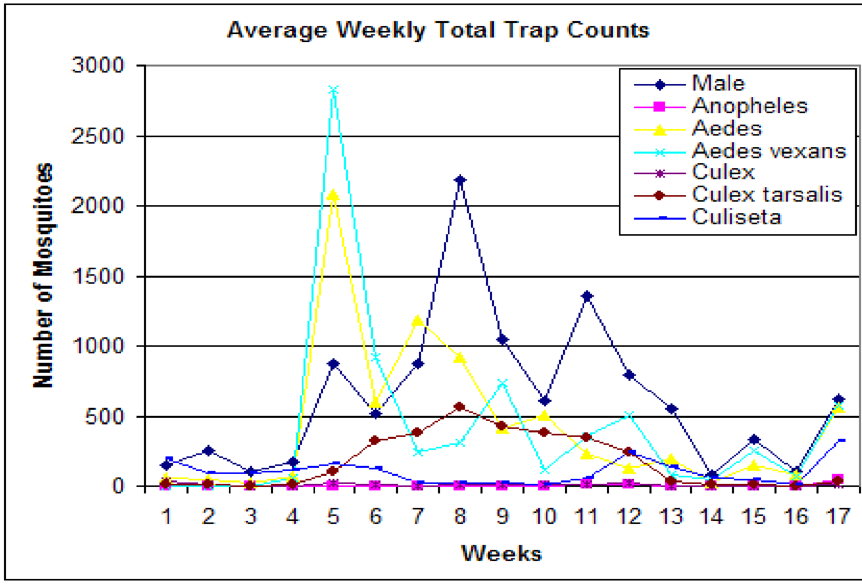


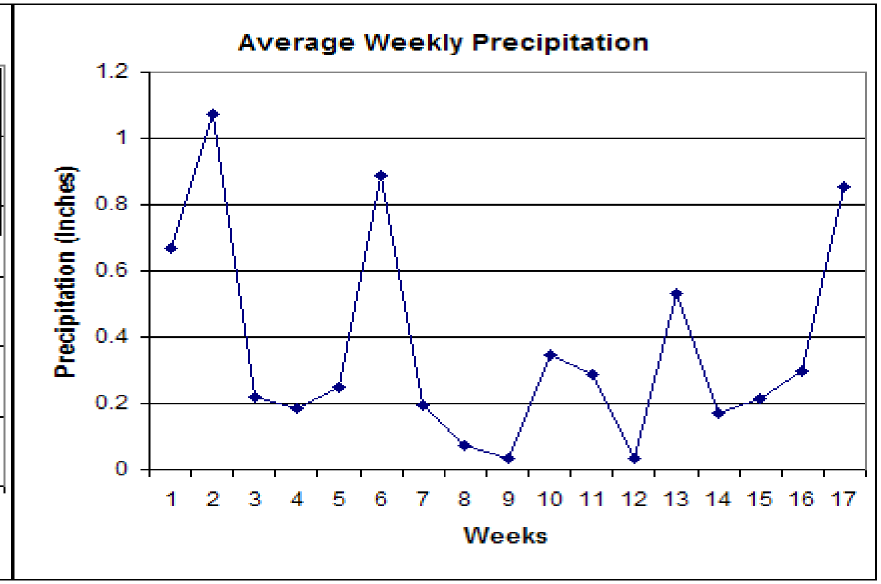


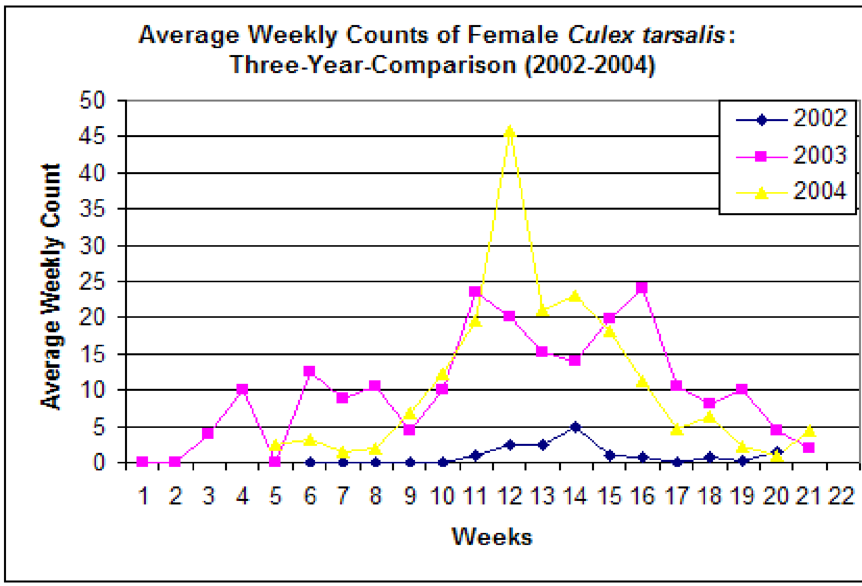


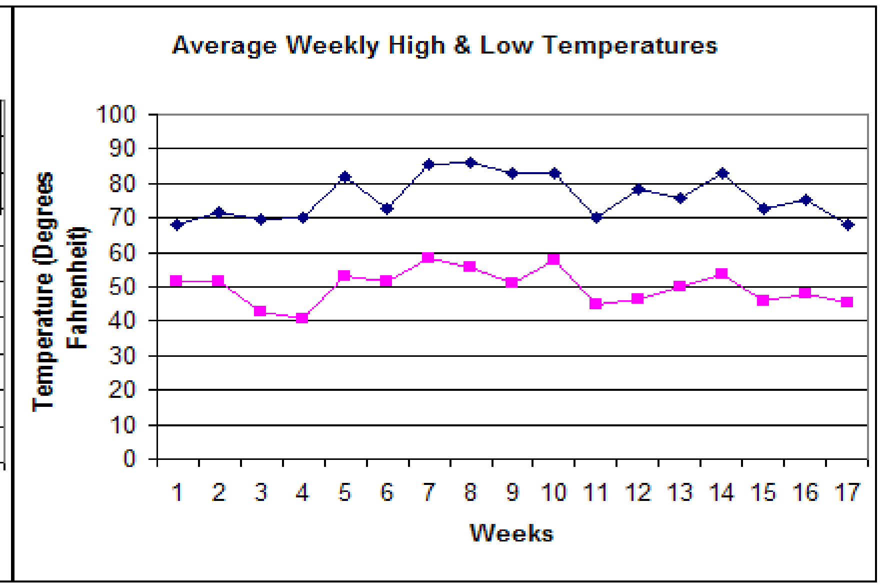


2004 North Dakota Mosquito Surveillance Region VII
New Jersey Mosquito Trap Data Analysis

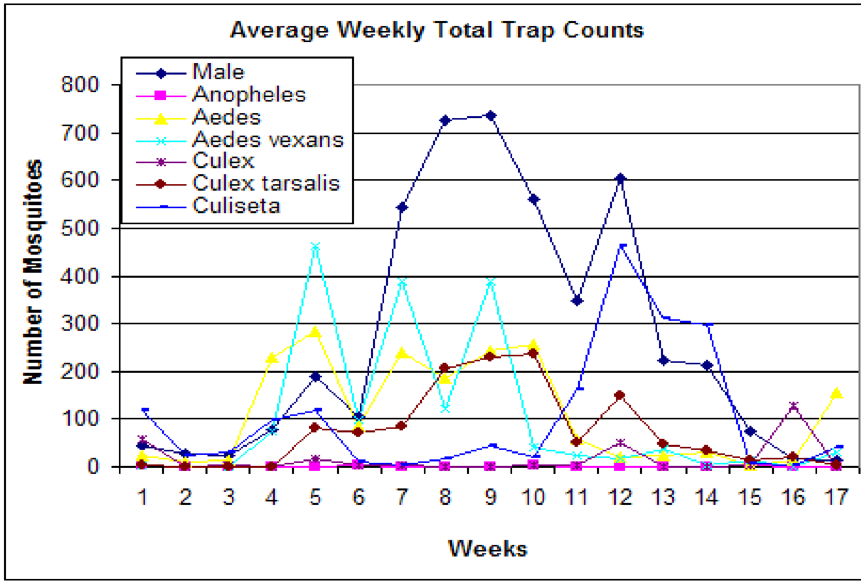


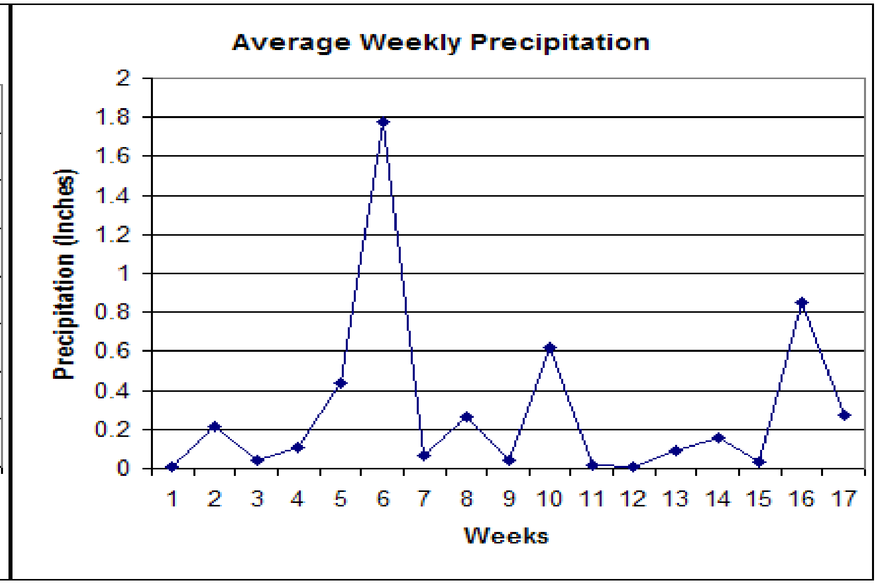


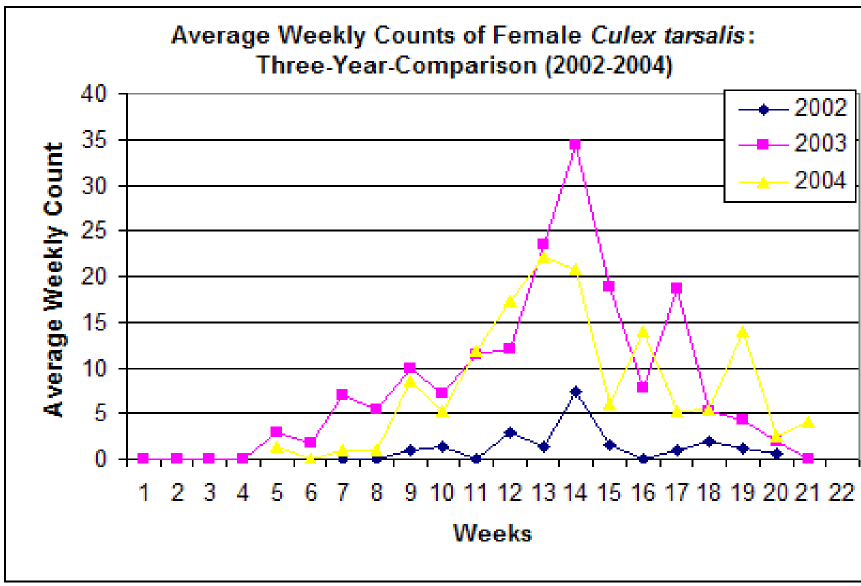


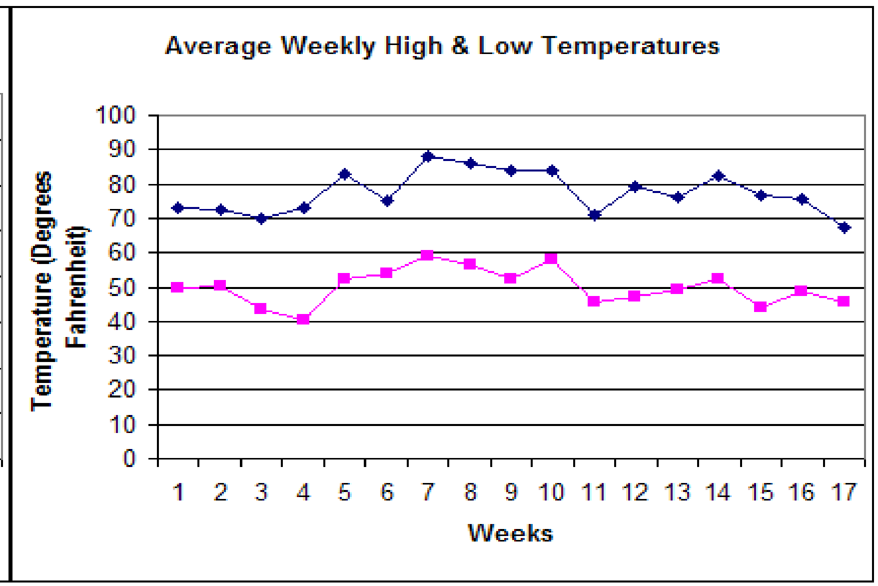


2004 North Dakota Mosquito Surveillance Region VIII
New Jersey Mosquito Trap Data Analysis



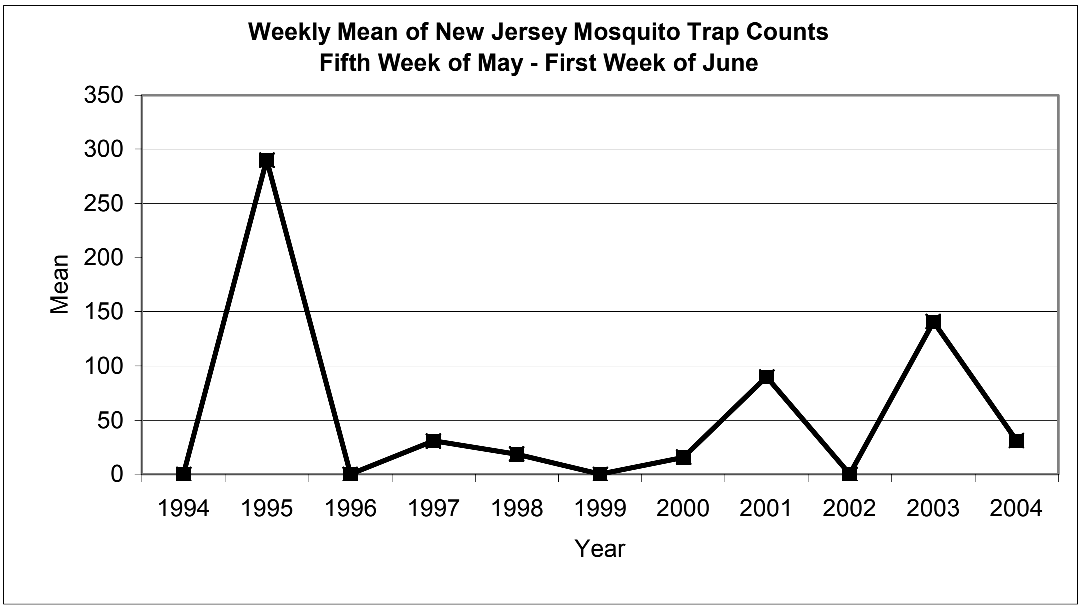


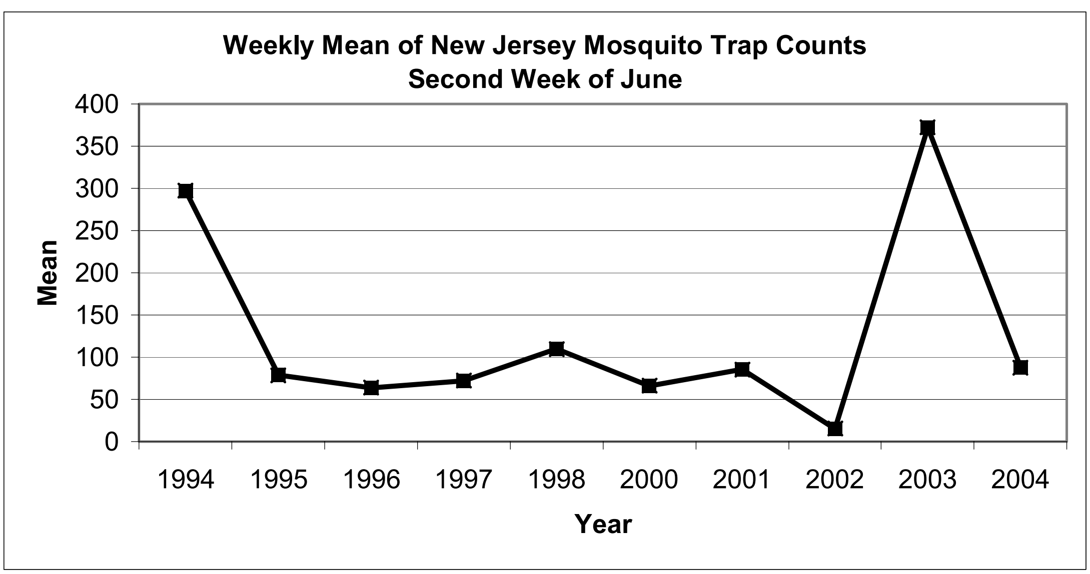


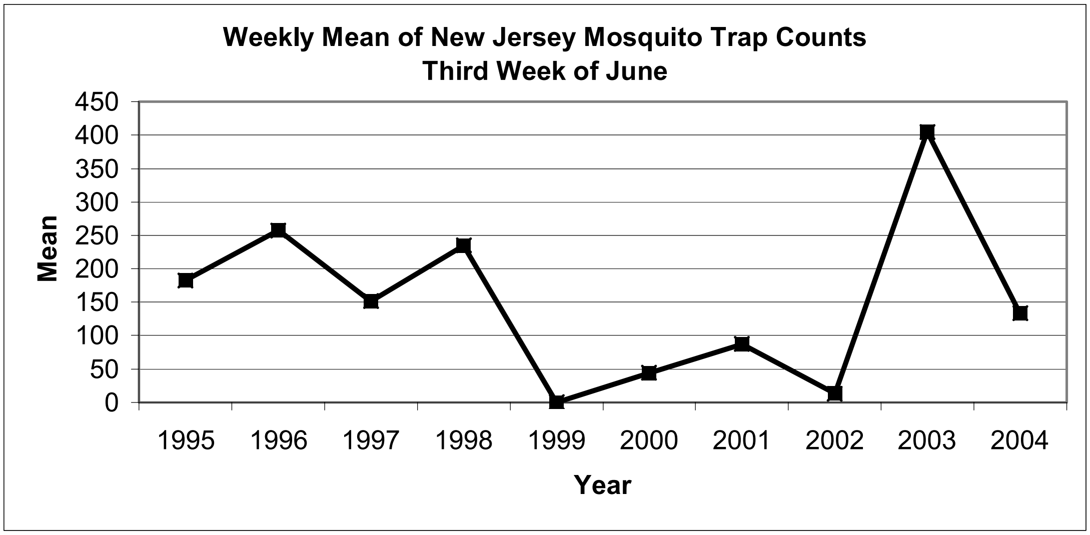


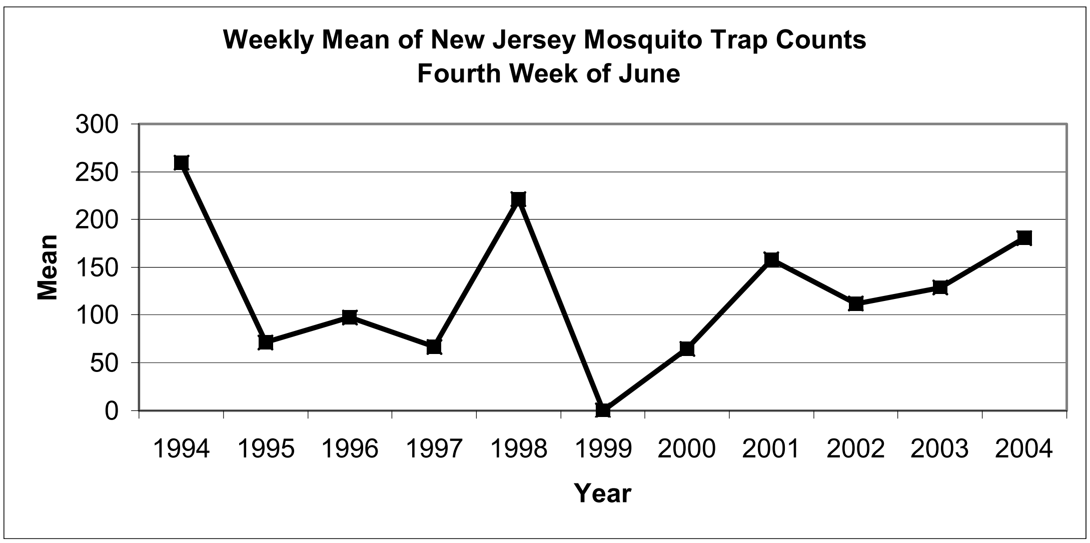
Appendix B includes graphs of the annual trap counts from the last week of May through the last week of September. These graphs depict how the mosquito trap counts have changed between 1994 and 2004. Each year, the general trend of North Dakota's mosquito population is a steady rise in population peaking in early to late July, followed by a gradual decrease through the rest of the mosquito season. Yearly and weekly variances in trap numbers can be attributed to factors such as rainfall, temperature and wind speed.

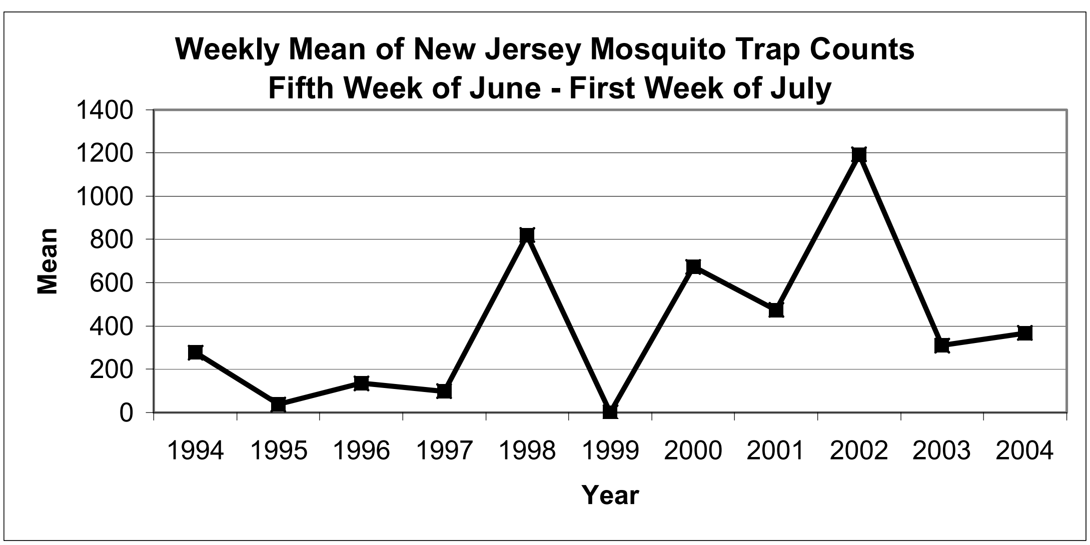
Weekly Mean of New Jersey Mosquito Trap Counts from 1994-2004

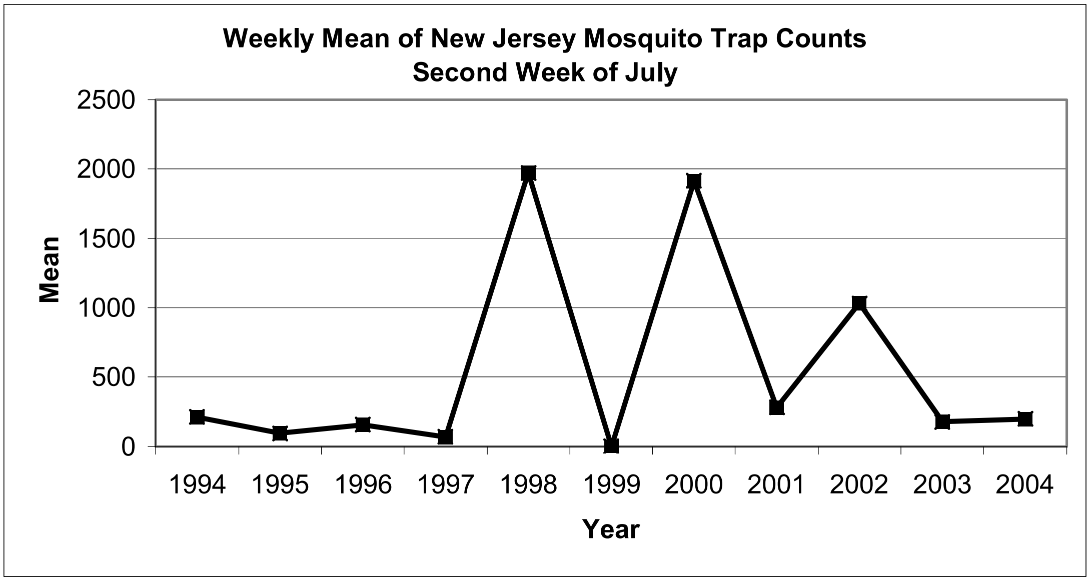


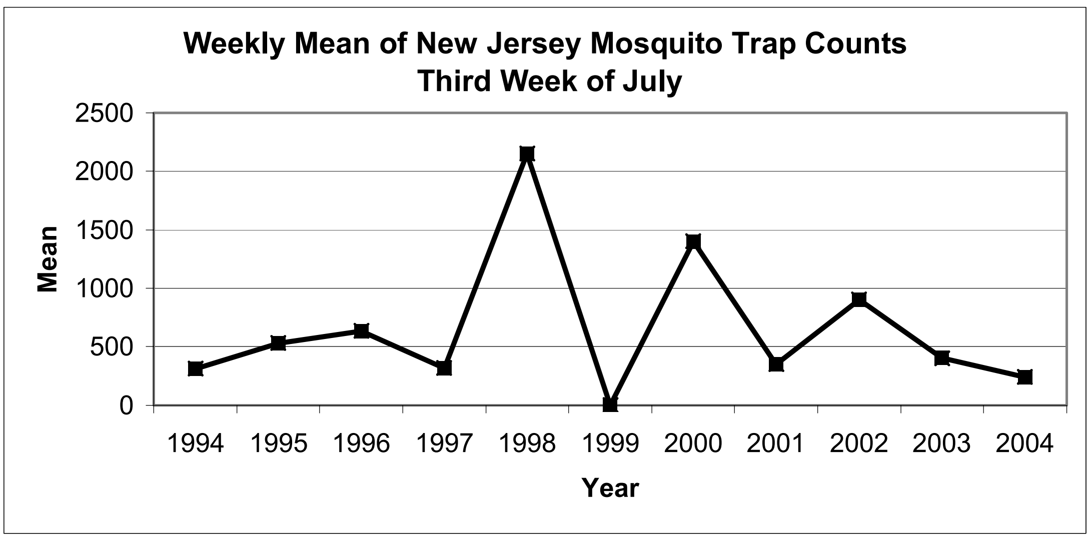


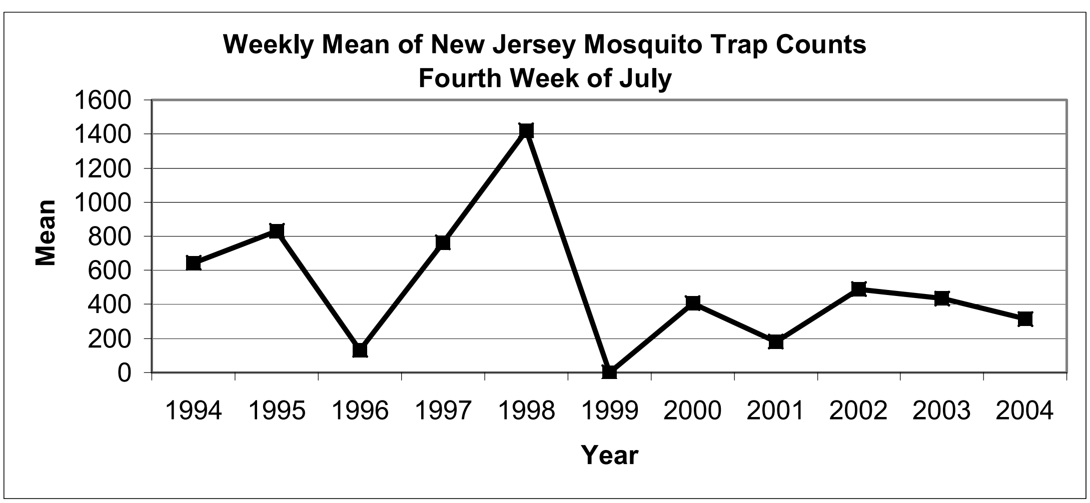

Weekly Mean of New Jersey Mosquito Trap Counts
Third Week of June
450
400
350
300
250
200
150
100
50
0
Mean
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

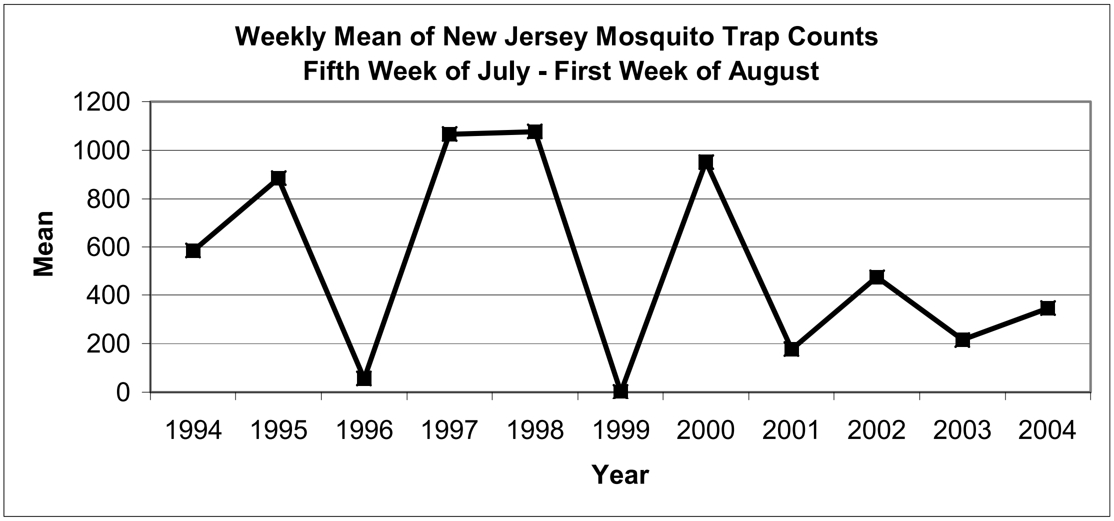

Weekly Mean of New Jersey Mosquito Trap Counts
Fourth Week of June
300
250
200
150
100
50
0
Mean
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

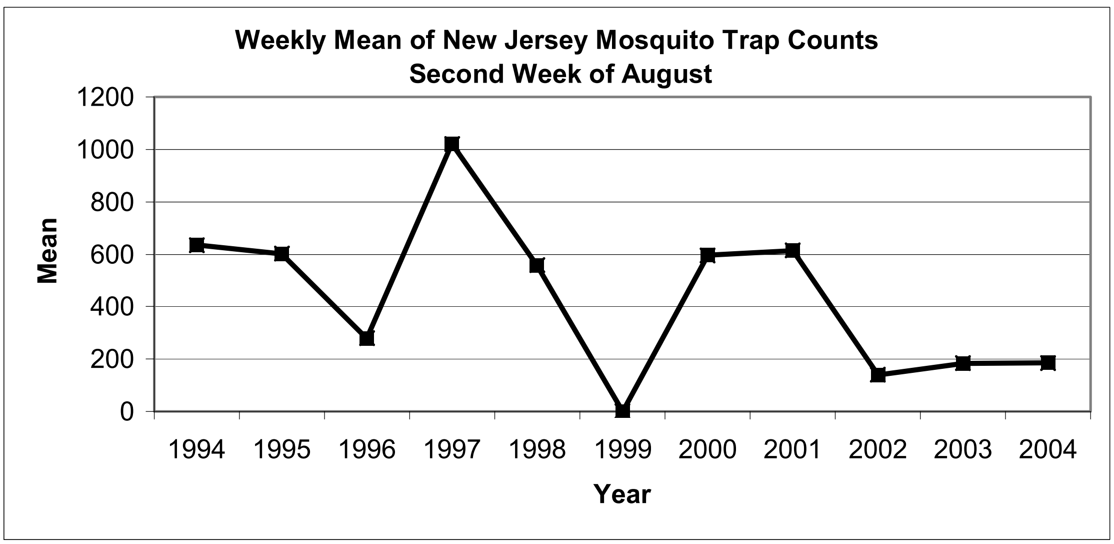

Weekly Mean of New Jersey Mosquito Trap Counts
Fifth Week of June - First Week of July
1400
1200
1000
800
600
400
200
0
Mean
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

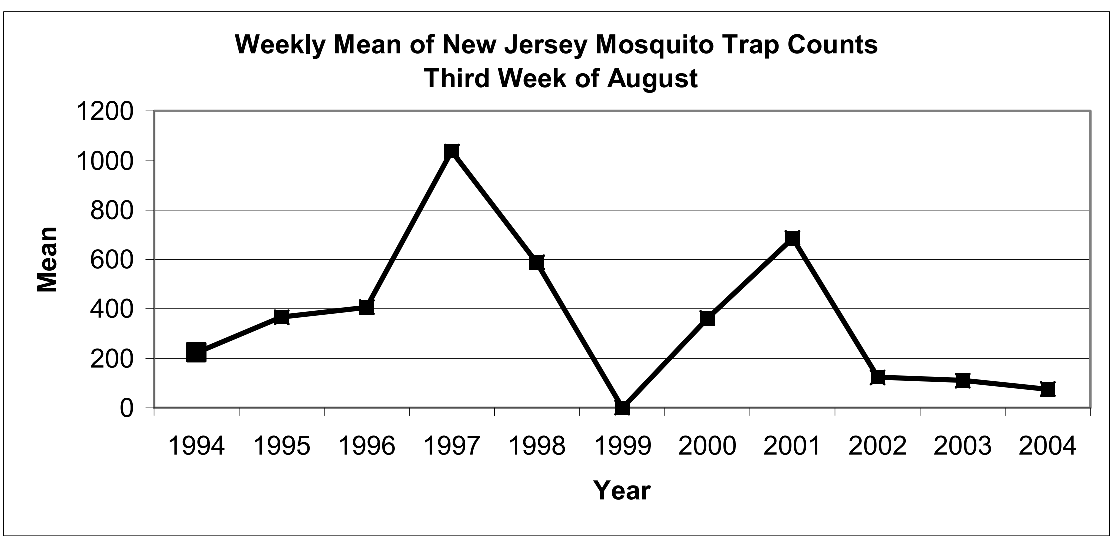

Weekly Mean of New Jersey Mosquito Trap Counts
Second Week of July
Mean
2500
2000
1500
1000
500
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

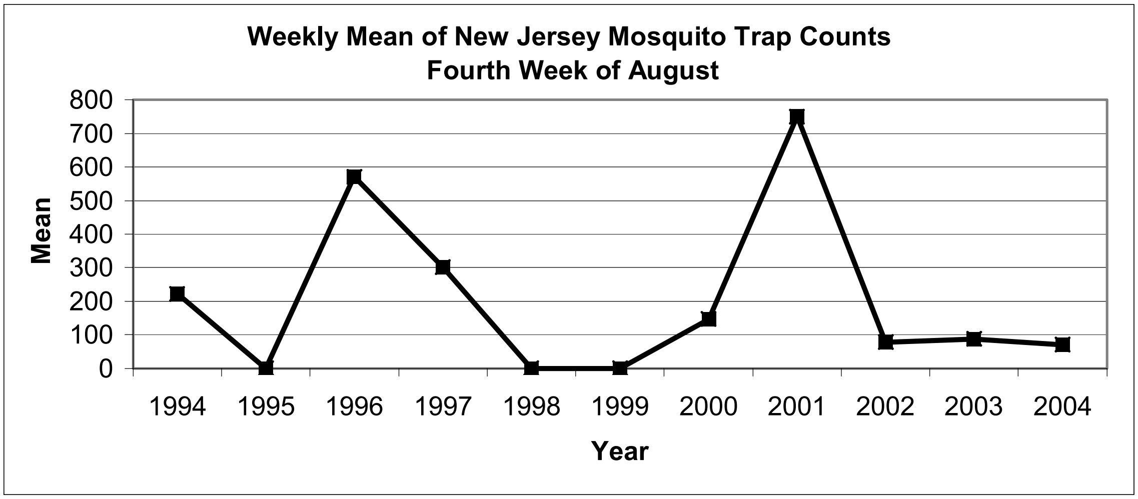

Weekly Mean of New Jersey Mosquito Trap Counts
Third Week of July
Mean
2500
2000
1500
1000
500
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

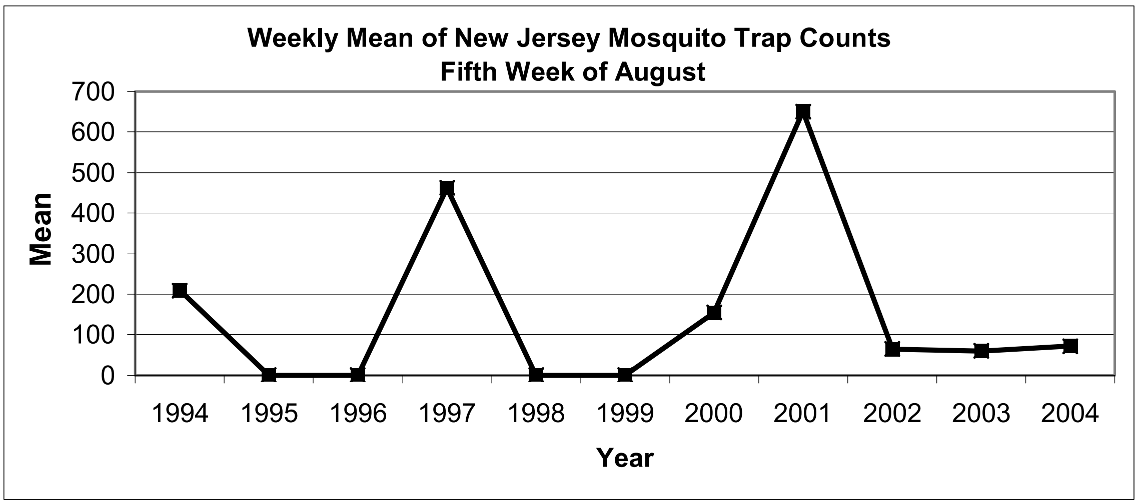

Weekly Mean of New Jersey Mosquito Trap Counts
Fourth Week of July
Mean
1600
1400
1200
1000
800
600
400
200
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

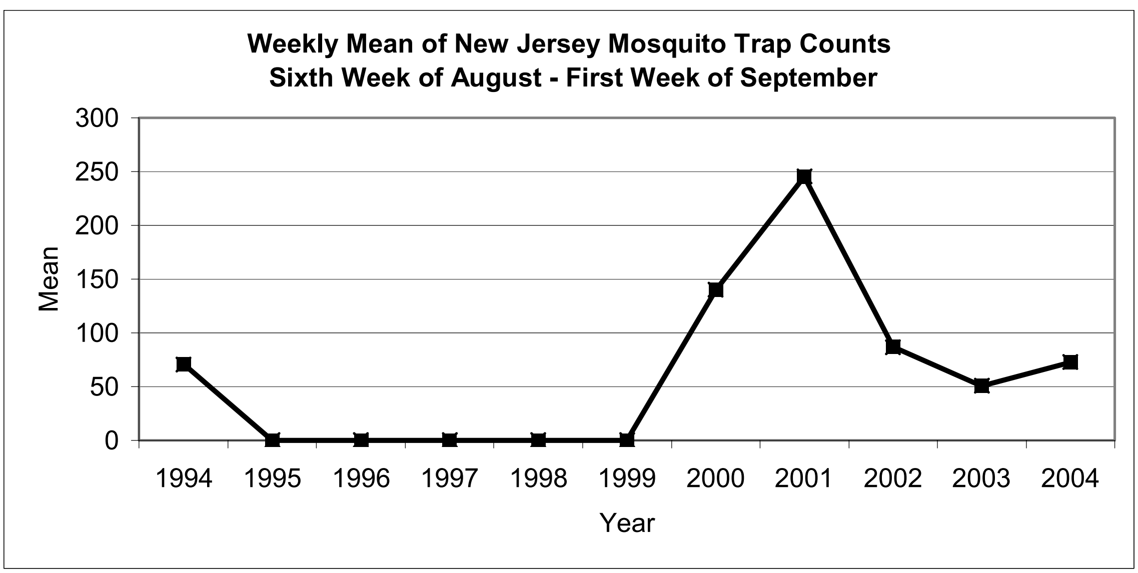

Weekly Mean of New Jersey Mosquito Trap Counts
Fifth Week of July - First Week of August
Mean
1200
1000
800
600
400
200
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

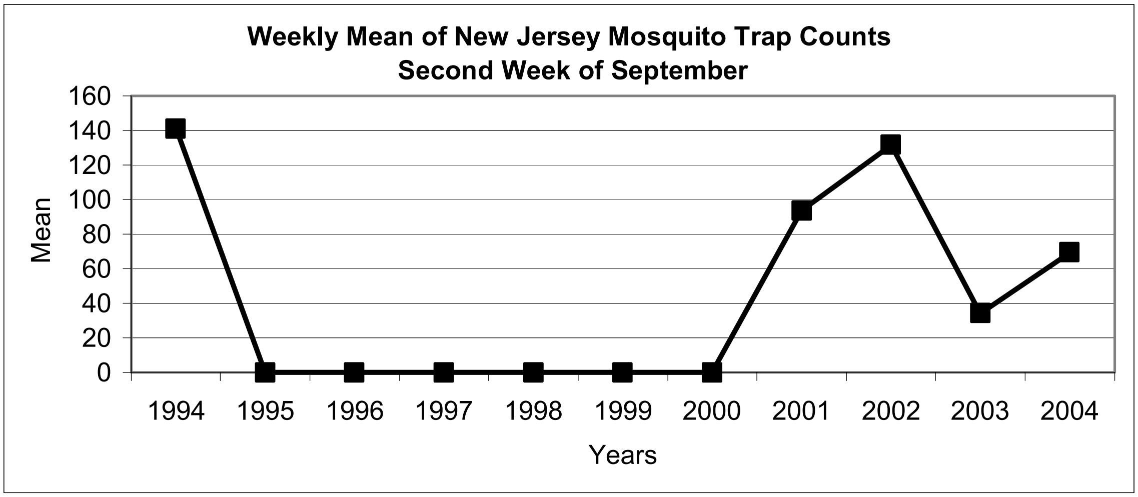

Weekly Mean of New Jersey Mosquito Trap Counts
Second Week of August
Mean
1200
1000
800
600
400
200
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

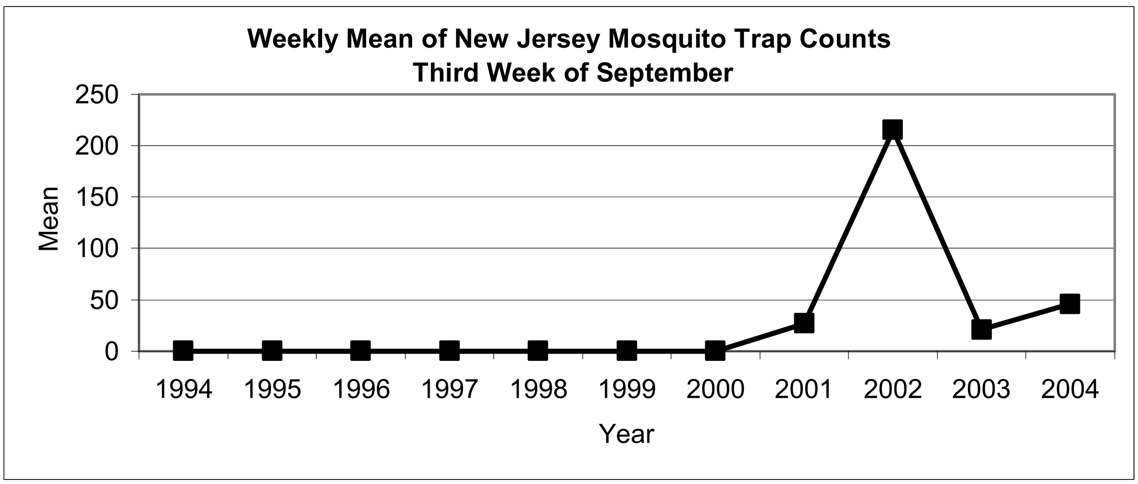

Weekly Mean of New Jersey Mosquito Trap Counts
Third Week of August
Mean
1200
1000
800
600
400
200
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

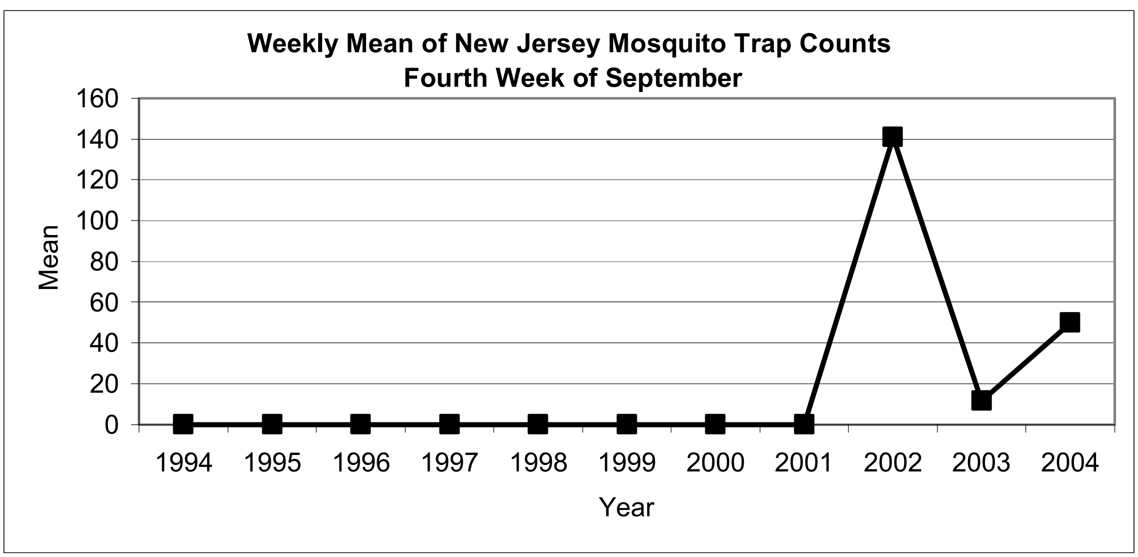

Weekly Mean of New Jersey Mosquito Trap Counts
Fourth Week of August
Mean
800
700
600
500
400
300
200
100
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year


Weekly Mean of New Jersey Mosquito Trap Counts
Fifth Week of August
Mean
700
600
500
400
300
200
100
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year


Weekly Mean of New Jersey Mosquito Trap Counts
Sixth Week of August - First Week of September
Mean
300
250
200
150
100
50
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year


Weekly Mean of New Jersey Mosquito Trap Counts
Second Week of September
Mean
160
140
120
100
80
60
40
20
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Years


Weekly Mean of New Jersey Mosquito Trap Counts
Third Week of September
Mean
250
200
150
100
50
0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year


Weekly Mean of New Jersey Mosquito Trap Counts
Fourth Week of September
Mean
160
140
120
100
80
60
40
20
0
1994
1995
1996
1997
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2000
2001
2002
2003
2004
Year

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